Australia's Top Selling Electronics Magazine

Electronics Australia

SEPTEMBER
1986
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FM TRANSMITTER
FOR MICROPHONES

Build these
2-WAY
HIFI
SPEAKERS

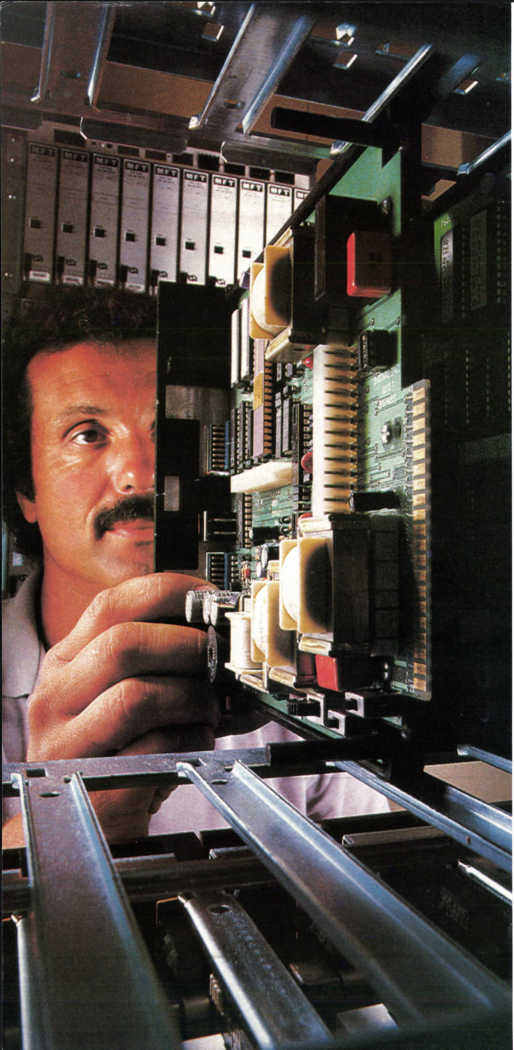
COOL-DOWN
TIMER FOR
TURBO CARS

XTRA CHANNELS
r the Explorer
Transceiver

We test . . .
TOSHIBA'S
PORTABLE
CD PLAYER

REVIEW:
pson PC

IN-DEPTH
BATTERY
SURVEY
Pt. 1



TEXA
TMS32

OVERVIEW

TI's TMS320 family comprises six high-speed digital signal processors (DSPs) — the broadest family of these devices available today. All are capable of implementing complex, numeric-intensive algorithms in real time. Among them you can find the device to meet a wide range of price/performance goals. While family compatibility reduces development costs and speeds time to market.

TI's DSP family is a reliable, flexible replacement for analog systems, and it provides designers with high-performance alternatives to conventional microprocessors and microcontrollers.

The Harvard architecture of TI's TMS320 family increases parallelism fo higher throughput; and these economical, programmable, general-purpose DSPs can accomplish many tasks that formerly required expensive custom or bit-slice solutions. As the industry standard, TI's TMS320 family minimizes your design risk.

APPLICATIONS

DSP is finding applications as varied as:

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- Voice/speech processing
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- Control systems
- Instrumentation

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- Consumer goods
- Automotive
- Medical
- Military

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NSTRUMENTS
IGITAL SIGNAL PROCESSORS

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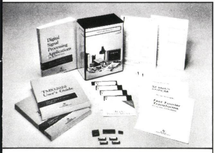
WITH TI's
PROCESSOR
OF CHOICE.

exas Instruments' general-purpose SPs are cost-effective solutions — not nly to realtime communications tasks, ut to a wide range of applications nvolving high-speed, numeric-intensive omputations. In telephony, data ommunications, graphics applications, ndustrial controls, general signal iltering . . . The possibilities are ounded only by your imagination. TI rovides solutions to do your whole job — not just part of it.

Off the drawing board . . . into the hardware of choice

et Texas Instruments help speed your SP project to market. Get the TMS320 SP Design Kit (TMS320DDK). It ontains the key building blocks you eed to prototype your system: DSPs, eripherals, more than 700 pages of pplication notes, and four floppy disks with applications source code. It's a ost-effective way to get started. And ou can get it from your nearest TI ield Sales office or authorized istributor now.



Everything you need to prototype your DSP system — from chips to code — is included in TI's TMS320 Design Kit.

In-depth support for TI's TMS320 family of DSPs includes host-independent development systems, an evaluation module, an emulator, and an analog interface board, as well as assembler/linkers and simulators that can run on a variety of host computers and PCs. Documentation and application support are extensive and thorough.

TI's TM320 FAMILY OVERVIEW

	MEMORY				CYCLE-TIME				PACKAGE				I/O		INSTRUCTIONS	TECHNOLOGY	SMJ MILITARY
	ON CHIP		OFF CHIP		ns				DIP	PGA	PLCC		SER	PAR			
	RAM	ROM	PROG	DATA	200	160	125	100	40	68	44	68					
TMS32010	144	1.5K	4K		✓	✓			✓		*✓			8x16	60	NMOS	✓
TMS32011	144	1.5K			✓				✓				2	6x16	60	NMOS	
TMS320C10	144	1.5K	4K		✓	*✓			✓		*✓			8x16	60	CMOS	*✓
TMS32020	544		64K	64K	✓					*✓			1	16x16	109	NMOS	*✓
TMS320C25*	544	4K	64K	64K			✓	✓				✓	1	16x16	133	CMOS	*✓

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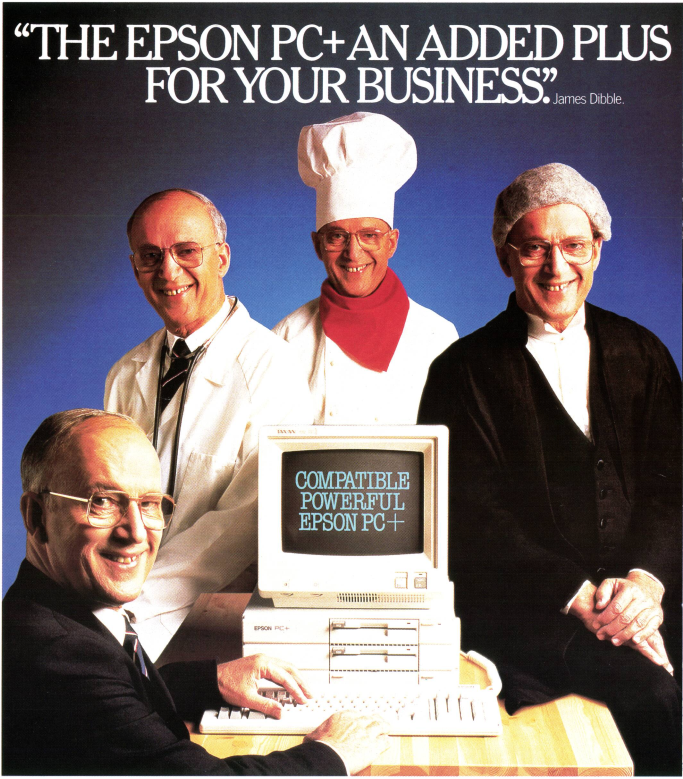

"THE EPSON PC+AN ADDED PLUS FOR YOUR BUSINESS." James Dibble.
COMPATIBLE
POWERFUL
EPSON PC+
EPSON PC+

Now the Epson PC family has an added plus. It's called the PC+, a fully compatible personal computer for all those people whose business or profession demands a more powerful personal computer.

The Business Computer of the Year's big brother.

The PC+ has all the features that made Epson PC winner of Business Review Weekly's Business Computer of the Year award. The same legendary reliability. The famous Epson twelve month warranty. And the same amazingly compact size.

The technical pluses you're after.

The Epson PC+ also boasts the technical pluses its name implies. Like double the processing speed, a standard 640K RAM and five expansion slots making it ideal for networking.

There's a dual speed microprocessor, precision keyboard and options including a 20Mbyte hard disk and a 1.2 Mbyte floppy disk drive.

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Volume 48, No.9

Electronics Australia

September 1986

THIS MONTH'S COVER

Build this compact hifi loudspeaker system and save yourself a bundle. It's a perfect match for the new Playmaster Sixty-Sixty stereo amplifier. See page 36.

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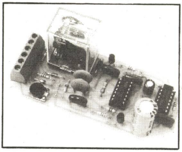
Cool-down timer for turbo cars

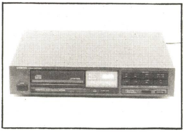


Got one of those new turbocharged cars? This simple project will stop the turbocharger from overheating. We show you how to build it on page 24.

What's coming

Next month, we intend to describe a stereo preamplifier with infrared remote control and an "industrial-strength" electric fence. See page 133 for further details.

Do CD players sound the same?



So how do CD players sound? Are there differences between models? Don't believe everything you hear from your local hifi dealer or read in the popular press. In this month's Forum, we give you the facts. See page 20.

MANAGING EDITOR
Leo Simpson, B.Bus. (NSWIT)
EDITOR
Greg Swain, B.Sc. (Hons. Sydney)
EDITORIAL CONSULTANT
Neville Williams, F.I.R.E.E.
(Aust.) (VK2XV)
TECHNICAL STAFF
John Clarke, B.E. (Elec. NSWIT)
Colin Dawson
Louise Upton
GRAPHIC DESIGNER
Brian Jones
ART PRODUCTION
Alana Horak
PRODUCTION
Mark Moes
SECRETARIAL
Carmel Triulcio
ADVERTISING PRODUCTION
Brett Baker
Vikki Patching (Vic)
ADVERTISING MANAGER
Selwyn Sayers
PUBLISHER
Michael Hannan
HEAD OFFICE
The Federal Publishing Company Proprietary Limited, 180 Bourke Road, Alexandria, NSW 2015. Phone: (02) 693-6666. Fax Number: (02) 693-2842. Telex: AA74488. Postal Address: PO Box 227, Waterloo 2017.
Representative: Norman Palmer.
INTERSTATE ADVERTISING OFFICES
Melbourne: 23rd Floor, 150 Lonsdale Street, Melbourne, Vic 3000. Phone: (03) 662 1222.
Representative: John Oliver, B.A. (Hons. Essex).
Adelaide: John Fairfax & Sons Ltd, 101 Weymouth Street, Adelaide 5000. Phone: (08) 212 1212.
Representative: Dane Hanson.
Brisbane: 26 Chermside Street, Newstead, Qld 4006. Phone: (07) 854 1119.
Representative: Bernie Summers.
Perth: John Fairfax & Sons, 454 Murray St, Perth, WA 6000. (09) 481-3171.
Representative: Jim Wells.
New Zealand: 3rd Floor, Communications House, 12 Heather Street, Parnell, Auckland, New Zealand, PO Box 37-291. Telex: NZ63122. Telephone: 79 6648.
Representative: John Easton.
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Letters to the editor

The July Forum article on the subject of parts availability has attracted the biggest reader response ever for any one subject. Below we publish a respresentative selection of the letters received.

Playmaster tuner is good value

After reading the article "Utopiatronics" and its related letters in the July issue, I am almost seeing red. I can not agree with N.M. and his supporters.

It seems that they cannot appreciate the work you have done. You have spent an incredible amount of man-hours in developing the Stereo AM/FM Tuner and now you should almost apologise for the price!

I can almost understand their problem as far as money goes, but not quite. From my own experience, the longer a project takes, the higher the bill. If you buy a lot of components in one hit, you may get a discount. On the other hand, if you wait several months and buy individual components, the price usually goes up. Where is the saving?

Because my wife does not work, we cannot afford to spend too much either. But if I want ultimate performance I am prepared to pay the price. This is not the case with the tuner however, as its price is right down on the ground compared to other tuners.

At first, I thought that your statement about it "outperforming almost anything on the market" was a bit far fetched. Then I compared it with well-known brand tuners (no cheapies) and my jaw hit the ground. None of these tuners could put a shadow over the Playmaster, even though some were in the $1000 to $1500 region.

Some time ago I built the Playmaster Series 200 Amplifier as well as the 3-way Vifa loudspeakers described by your competitor and it performs A1. Good on you. I did not buy the whole kit for the amplifier as I needed only the power modules and I had some parts already on hand.

I would not dare build the tuner in the same way — good luck to those who will. Let someone else worry about buying the parts separately. I am ready to buy it as a kit but I am not saying that I would not like to see all the part from kits behind the counter.

As the first batch of tuner kits disappeared from Jaycar stores in the firs few days, I have placed an order and paid in advance to ensure that I will ge one of the next batch. I am looking forward to it. All these thoughts are mostly shared by my "electronics" friends, so I am pretty sure of not being a black sheep.

I hope that letters such as from N.M will not discourage your team from other "expensive" projects.

P. Wolf
Ashfield, NSW

Prefers to buy parts separately

In response to your Forum article in the July 1986 issue titled "Utopiatronic — the hobbyists dream could come true", I would like to add my bit.

Firstly, as an aside, let me say I have followed EA for many years and expec to subscribe to it for many years to come. I enjoy reading EA immensely.

I am a very low-key hobbyist who dreams of becoming a genius designer but that's as far as it will ever go. Other commitments and interests prevent me from getting into it enough to actually understand much beyond the rudimentary basics.

However, I do like to dabble once in a while with projects I can both find a use for and enjoy the satisfaction of having built them.

Back on the tracks again, many projects have appealed in the past but I have not had a go because they were too expensive on a once-off basis. I stil keep the circuit notes in a box in the hope I will one day go back and build some of them. Every once in a while I go through and cull out those that have had their day.

If projects could be purchased piecemeal, so that you had enough to keep you busy for a while, I would definitely be spending and building more — perhaps as much as $600 to $800 per year more. The problems for me are:

(1). To convince my wife I'm not spending too much. Small parcels look less expensive than large parcels and they take up less space. This lessens the risk of irritation which may otherwise bring the axe down on the whole lot.

(2). I don't like spending a fortune in one go, only to eventually damage or lose bits because they sit around too long. To avoid this, I tend to devote too much time in getting the thing built so that it won't irritate others in the house, thus neglecting other responsibilities.

(3). In some kits, I have been disappointed with the quality of the parts supplied and so prefer to shop around for the best quality components.

As I mentioned earlier, I lack the knowledge to delve too deeply so, if it doesn't work correctly at switch on or after some basic checks, I would be at a loss what to do if it was a complicated component failure. At least by using known quality parts I reduce my risks, and I don't mind the extra cost if spread over time.

D. Sinclair,
Rozelle, NSW.

Parts, boxes and fault-finding

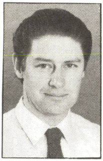
I have been reading with a great deal of interest your Forum columns in the last three issues regarding parts availability.

Your request for comments has prompted me to put pen to paper. Whilst I do purchase complete kits, though not in the $400 variety, I would prefer to purchase only the PCBs and the electronic components.

As I have two major hobbies, that of woodwork and electronics, I am naturally interested in combining the two. The plastic boxes supplied with most kits do not impress me. Where possible, I mount my kits in a furniture-quality woodgrain box of my own design and manufacture.

I therefore support the idea of suppliers selling both full kits and short kits, r the major electronic components. I vould purchase more parts and attempt nore projects if I was able to buy the its and pieces separately.

May I add that I feel a lot more emhasis should be placed on testing and ault finding when a project is pub-



Editorial Viewpoint

The Aussie dollar: let's seize the opportunities

By the time you read this, I'm betting that all the gloom and doom about the state of the Australian economy and our embattled currency will have started to lift. We probably will be already coming to terms with the toughest budget since the second World War and taking stock of the opportunities that we now have.

And make no mistake. We now have wonderful opportunities to compete with imports on our own markets and better yet, to compete on the international markets.

For too long, Australian business people have bemoaned our disadvantages: small home market, distance from the rest of the world, high labour costs and so on. Well, the effective 50% devaluation of our currency against the Japanese yen over the last year or so, combined with our historically low increases in labour costs, has made nonsense of all that.

In terms of labour costs, we are now competitive with virtually every developed country in the world. In many industries we can now compete head to head with the Japanese. And indeed we are, although you would not know it by reading the daily newspapers.

We can and will recapture much of our local car and truck market. From there we should go on to export to other countries. There seems to be no good reason why not. After all, if General Motors Holden once exported 25% of its production why shouldn't it happen again? And if things look promising in the longer term for the local motoring industry they will also look good for electronics manufacturing. The automotive industry is an increasingly larger buyer of electronics components and assemblies. And while we probably won't see a resurgence of a consumer electronics industry, in other areas our local companies will be very competitive.

In other words, it isn't all black. There are many opportunities presented by the fact that our historically strong export-income earners, agriculture and mining, have become weakened. Over the last decade or so, we have focussed on these to the exclusion of secondary industries. This new turn of events will help focus the Nation's attention to the importance of rebuilding our industrial base.

To my mind, that is a very positive outcome. It promises quite a few benefits: more employment, replacement of imported products with locally built equivalents (to help our trade balance), more diversified export earnings, and perhaps the most important in the long term, the re-building of our Australian manufacturing skills. Do I hear a chorus of "Hear hear"?

Leo Simpson

Letters to the editor

lished. I purchased an oscilloscope recently to get an "inside view" of circuit operations. This unit is now invaluable when testing a completed project. May I suggest that some CRO "pictures" accompanying each project would be a major advantage.

Finally, I would like to thank you for a most informative magazine. Almost all of my electronics knowledge has been gleaned from magazines and the booklets advertised in them.

A. Hay,
Cooran, Qld.

Kits situation needs reforming

I am writing to you in response to your suggestion to take up the "challenge" concerning the recent subject matter introduced in your Forum pages. I give my enthusiastic support to N.M. and his letter concerning "Utopiatronics".

I strongly agree that the kit situation is desperately in need of reformation. There is obviously much demand for hard to get components to become available "off the shelf". So why then have the kit suppliers neglected th hobbyists in the electronics world?

You only have to look at the recen "engineering" catalogs to get the general picture. Components and "nick nacks" are becoming more and mor difficult to find amid the glossy pages o ready-made products.

The situation is bad. Many an *Electronics Australia* project I liked I coul not build simply because of the ki price. Ask about buying single "thingoes or whatsits" and you are given th cold shoulder. Help!

You run an excellent magazine. Kee up the good work!

David Ius
Strathfield West, NSW

The view from Dick Smith Electronics

I have followed with interest the Forum discussion on "Utopiatronics" in recent issues.

Suffice to say, an organisation like ours welcomes suggestions from kit constructors on how to improve our kits (after all, we owe our existence to hobbyists), and I wait with baited breath for subsequent letters on the subject.

However, an explanation on my part may help readers understand why Dick Smith Electronics (DSE) presents kits the way it does.

Any magazine project DSE kits up for must be commercially viable. Most readers can appreciate that whilst a project described in a magazine may have technical merit, this doesn't necessarily mean it has commercial merit. As Gary Johnston points out, the investment required to 'kit up' for a project can be enormous considering the manpower involved and the parts stock holding. So there must be a light at the end of the tunnel to make the investment worthwhile.

Bear in mind that this country has a relatively small population. A small percentage of the population are electronics hobbyists and a percentage of these buy and build kits.

I.G. stated his disappointment with the 100 Watt VHF Amplifier in the March issue not being available in other than kit form, as he is not prepared to outlay $249.00 in one hit. This project was conceived in order to provide a low-cost alternative to similar commercial devices. The performance of the kit amplifier is, I believe, equal to or better than commercial units costing well in excess of $400.00

If DSE had not designed the amplifier or *Electronics Australia* had not published the article, what would I.G. have done? I'm sure that no supplier is offering amplifiers for sale on a bit by bit basis. Of course, I.G. could always buy a unit on credit and thereby incur the added cost of interest, or perhaps he could put it on lay-by, but then he couldn't possess it until he paid for it. The other alternative would of course be to go without it.

I.G. may be surprised to learn that with the exception of the heatsink, case and PCB all other parts can be bought from local suppliers. Assuming we made those parts available in our stores, would I.G. still be prepared for the cost of bit by bit construction? Consider the following:

- MRF247 transistors (equivalent to 2SC2694 as used) are frequently advertised in the magazines. Cost — around $58.00 each; two required.
- Coaxial relays DSE Cat. No. S7402. Cost — $34.50 each; two required.

Cost so far — $185.00! What I am trying to point out is that the cost of the kit is less than the cost of the individual parts!

Several writers have made the comment that we should only design kits using 'standard parts'. This severely limits the type of projects that organisations like DSE or EA can provide. If we were to adopt this policy, there simply would be no Teletext Decoder, Stereo TV Receiver, amateur transceiver projects, Series 200 amplifier, Algernon robot, EA tuner etc.

Our aim is to place the latest technology in the hands of hobbyists in the most economical manner, and I believe we do achieve this, to a large degree.

We believe (or believed) that most constructors prefer a complete kit o parts. In fact, in most instances, it i cheaper for the hobbyist to buy a complete kit of parts rather than the individual parts. However, if constructor really only want a pack of hard to ge parts, we'll consider this as an alternative.

If we can be convinced that a sufficient market exists for short form kits or individual parts, then we will make every effort to provide this service fo our customers. If you don't write and tell us, we must assume that the majority are satisfied with the status quo.

The reference to the size of our market in this country brings me to the point concerning the quality of kits and instructions raised by I.G. in the July issue.

If we had a worldwide market and the resources and funds for development that Heathkit does, I have no doubt that we could produce kits of a similar standard. The Heath Company will easily spend hundreds of thousands of dollars in developing a kit, a sum that we could not possibly consider for the Australian market because the consumer would not be prepared to pay the price required to cover development costs.

One thing that I.G. fails to mention is how much he paid for his American kit and whether he bought it in instalments!

The hobbyists of Australia must decide exactly what it is that they want. We are always prepared to listen to suggestions for improvements, but be realistic. There is no such thing as a free lunch!

Garry Crapp,
General Manager,
Technical & Enthusiast Products,
Dick Smith Electronics.

News Highlights

Rocky winner

Mrs Laurel Dumbrell, a Carss Park (Sydney) housewife, who also teaches writing to adults as a part time occupation with the Arts Council, was the lucky winner of a Daihatsu "Rocky" in a recent computerised draw which involved over 19,000 subscribers to Federal Publishing magazines.

"Rocky couldn't have come along at a better time," said a delighted Mrs Dumbrell.

"My husband and I have been renovating an old farmhouse on some land in the Kurrajong Hills and we badly needed a four wheel drive vehicle but couldn't afford one."

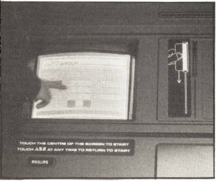
"I still can't believe our fortune — it's a tremendous thrill."

Mrs Dumbrell, a subscriber to Prevention magazine, is pictured receiving her keys to "Rocky" from Mr Rod Bragg, marketing manager of Daihatsu Australia.

Touchscreen automatic teller

Just when you may have thought automatic tellers were getting a little passè, along comes this new touchscreen model from Philips.

Claimed to be the most advanced automatic teller in the world, the machine has been installed at the ANZ Bank's Night and Day Centre in the Melbourne suburb of Balwyn. It is based on an interactive videodisc which gives customers full details of all the services available from the bank 24 hours a day, seven days a week — this in addition to conventional automatic teller services.


TOUCH THE CENTRE OF THE SCREEN TO START
TOUCH ANZ AT ANY TIME TO RETURN TO START
PHILIPS

Clones could outsell IBM

The struggle for the US computer market is hotting up as more and more PC clones — computers that run the same programs as the IBM PCs — pour out of factories in the US and Asia.

In fact, sales of the clones are growing faster than sales of IBM-made computers and, according to some analysts, this could be the year that the clones combine to outsell IBM. Some industry observers are even predicting that Korean and Taiwanese makers could drive prices in the IBM PC-clone market down into the $US500 range.

There are already some 70 Asian manufacturers of PC clones and most of these undercut IBM substantially. Another fierce competitor is Tandy Corp. of Fort Worth, Texas which offers three IBM-compatible models: the Model 1000, the Model 1200 and the Model 3000. In the US, the Model 1000 sells for as little as $699 with a monochrome monitor, or $999 with a colour monitor.

Multi-trip bus tickets

What are those orange objects on the NSW buses? According to a news release from the Urban Transit Authority, they will play a major role in rationalising the bus fare system later this year.

The 'multi-trip' ticket is offered at a discount rate and is for use in the special orange machines which are currently being installed in the Sydney and Newcastle bus fleets. A West Australian firm, Associated Electronic Services Pty Ltd, has been awarded the contract to build the optical recognition system which identifies the cardboard tickets.

Each multi-trip ticket entitles the holder to ten trips validated one at a time by inserting the ticket into the machine which will be near the driver. The machine then cancels the necessary units for each trip and prints the fare 'paid' on the ticket.

The system is mainly aimed at casual users and offers the chance for cheaper travel (ten tickets for the price of eight). The system also eliminates delays caused by paying cash and waiting for tickets and change.

News Highlights

Masking the microchip by laser

Developed in Britain by Ferranti Electronics, this new laser-driven pattern generator makes possible the manufacture of microcircuits at three times the speed of existing systems. The device uses a pulsed ultra-light laser to produce a reticle, which is a single image of one layer of a chip.

Each microcircuit consists of several layers and, from the reticles, an array of final size images is produced to form a mask. Light is then projected through the mask to form the images of the chip design on the silicon wafer. The system, which produces a similar image quality to conventional light sources, needs no special gases and operates from a standard clean room nitrogen supply.

Research into the system is actually part and parcel of a large European mask-making development project led by Ferranti and funded by the Esprit research program.

Europe in space by mid 1990s

According to recent overseas reports, France has won backing from the European Space Agency for Hermes, its proposed version of the space shuttle.

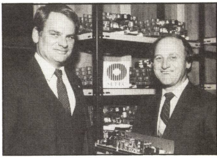
Hermes will be launched by a new cryogenic engine that is currently being developed and should be able to put European astronauts into space by the mid-1990s. France is expected to pick up half the $3 billion tab for the project, with Britain expected to commit at least $200 million.

The decision to go with Hermes pushes Britain's proposed spaceplane, called Hotol, into the background. Designed by British Aerospace and Rolls Royce, Hotol would take off and land horizontally using a new type of engine.

This engine, however, requires considerable development and Britain now hopes that Hotol will become the successor to Hermes.

Scientific Electronics changes name

Scientific Electronics, an Australian company which designs and manufactures switchmode power supplies, has changed its name to SETEC. Apart from the name change, it will be business as usual for the company which has volume contracts with the local computer industry and exports to both Asia and the USA. The company's address is 6 Holloway Drive, Bayswater, Vic 3153. Telephone (03) 762 5777.



Above: SETEC Managing Director Peter Lloyd (left) and General Sales Manager Ian Hansen.

AWA's technology group has new head

Mr Peter Nicholson, General Manager AWA Subsidiaries and Chief Executive of Electrical Equipment Ltd, has been appointed Group General Manager of the AWA Technology Group located at North Ryde.

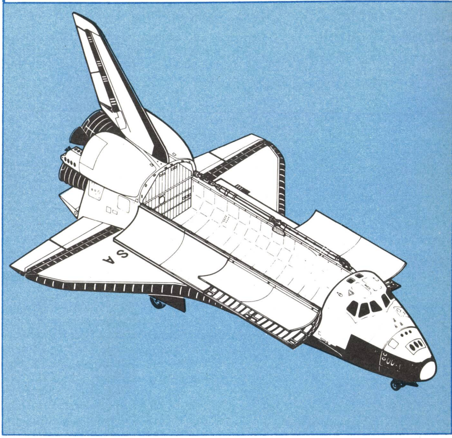
The Technology Group comprises four divisions of AWA: Defence and Transmission; Information and Control; Networking and Business Communications; and Microelectronics. AWA-Rediffusion and the Measurement and Control Division of Electrical Equipment Limited will be added to the Technology Group following Mr Nicholson's appointment.

Business Brief

New address for Technicraft Electronics

David Whitby's Technicraft Electronics has moved to 69 Sutherland Road, Armadale, Vic 3143. Telephone (03) 500 9064. Among other things, the company will continue to supply kits for projects featured under the Technicraft name in *Electronics Australia.*

Seminar to tell of space research opportunities



Crystal-growth experiments planned for Space Shuttle

NASA and the Boeing Aerospace Company recently entered into an greement to conduct a series of materils processing experiments when Space huttle flights resume.

The main objective of the experinents is to prove that crystals of a size nd quality impossible to create on Earth can be produced in space. These rystals are expected to be valuable in he commercial production of semiconluctor and electro-optic devices.

The experiments involve the manned peration of a chemical vapor transport rystal growth furnace which will be intalled in the galley area of the Shuttle rbiter's mid-deck compartment.

Boeing hopes to fly a total of three eparate furnaces on each of the three lights. Under the agreement, Boeing vill fund the experiments, and provide he crystal growth furnace and other eeded equipment.

Until now, Australia has well and ily missed the bus when it comes to ace research. But the opportunities e there according to Space Test Inc, a S-based company which has been avily involved in the NASA space ogram.

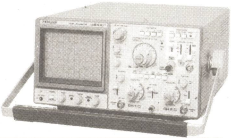
To drive the message home, Space st Inc. will be conducting a seminar space research in Sydney on 10th d 11th September, 1986. Speakers om companies involved in both US d Australian space research will adess the seminar, to be held at Sydy's Southern Cross Hotel.

The seminar program will be divided o two streams: technical requirements d management. Included will be such pics as structures and loads; thermal quirements; electromagnetic compatlity; alternative flight options to the uttle (eg, Ariane); and space law — name just a few. Case studies will inide updates and reviews of major ustralian projects such as Aussat and irrabooka.

Further information about the semir, which is co-sponsored by the Instiion of Engineers, Australia, can be tained from the Secretariat on (02) 8 2955.

SIMULATORS ARE common in the aviation industry but this unit, developed by Acet Ltd, a Perth engineering firm, is designed for training locomotive drivers. Two of the simulators have recently been purchased by Queensland Railways and will be installed at Gladstone and Mackay to train drivers employed in the coal mining industry. The contract is valued at $1.2 million. An earlier version of the Acet-designed simulator is already being used by mining companies operating heavy-haulage locomotives in the Pilbara. Britain, Brazil and China have expressed interest in the system.

More People choose KIKUSUI, because of ...



COS-5000TM Series

COS-5100TM 100MHz, 3CH, Delay Sweep
COS-5060TM 60MHZ, 3CH, Delay Sweep
COS 5042TM 40MHZ, 3CH, Delay Sweep
COS-5041TM 40MHZ, 2CH Delay Sweep
COS-5021TM 20MHz, 2CH, Delay Sweep
COS-5020TM 20MHz, 2CH, 3 Trace

★ *2 Switchable probes (10:1, 1:1) included with each KIKUSUI oscilloscope*

- **2 year Warranty** — means quality and reliability
- **Alternate triggering function** — makes troubleshooting easier
- **Peak-to-Peak trigger Level Lock** — no resetting between measurements
- **Variable Hold-off** — to stabilise flickering traces
- **DC trigger coupling** — to trigger slow waveforms
- **Linear Autofocus** — no refocusing between measurements
- **Excellent triggering**
- **Bright, Sharp traces**

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JAYCAR No. 1 for SILLY PRICES

BANANA REPUBLIC SPECIALS

Are you going Bananas over price increases? September is a slow month at Jaycar and we have slashed our prices to rock bottom. So don't "Monkey Around", at these prices we are only talking "Peanuts"!

2732A EPROM

Genuine Intel brand, 450nS

NORMALLY $10.00 each

ONLY

1 - 9 $3.50

10 - 24 $3.00

25 up $2.50 each

UNBELIEVABLE SEMICONDUCTOR BARGAINS!!!

MOTOROLA 6800 SERIES

6809
8/16 bit microprocessor - Cat. ZZ-8055
NORMALLY $10.00 each
$5.00 each

6821
Peripheral interface adaptor
Cat. ZZ-8061
NORMALLY
$5.00 each
$2.00 each

SILLY PRICES

6845
CRT controller - Cat. ZZ-8063
NORMALLY $12.00 each
$5.00 each

6850
Asynchronous communications interface adaptor
Cat. ZZ-8065
NORMALLY $7.00
$2.00 each

6818
Real time clock
Cat. ZZ-8057
NORMALLY $10.00
$3.00 each

MEMORY

27128
Cat. ZZ-8468
1 - 9 $5; 10 - 99 $4; 100+ $2.50

2114 RAM
Cat. ZZ-8414
1 - 9 $2; 10 - 24 $1.50;

SILLY PRICES

DB25 PLUGS & SOCKETS AT SILLY PRICES

(Solder cup, gold plated)

MALE Cat. PP-0840
$2.50 each
10 up $2.20 each
SAVE UP TO $1.75

FEMALE Cat. PS-0844
$3.00 each
10 up $2.75 each
SAVE UP TO $3.05

BACKSHELL Cat. PM-0848
$1.50 each
10 up $1.25 each
SAVE UP TO 95¢

DON'T HAVE A 1986 JAYCAR ENGINEERING CATALOGUE YET? SEND $1 AND WE WILL POST YOU ONE

"TUOHK" BOARD GAME

FOR COMMODORE VIC64 OWNERS

"Uinversity of the Hard Knocks". Basically the game works like this: You load a cassette into your VIC64 which contains 5000 "Trivia" type questions, community chest or chance type statements and other instructions.
Cat. XG-6000

WAS $49.95

NOW ONLY

$19.95

SAVE $30.00

WHAT A FLOP

AVTEK AUTOANSWER MODEM

Cat. XC-4822

$299

SAVE $50

TWEETERS

PIONEER brand cone tweeters
Cat. CT-2002
1975 PRICE.
ONLY $2 each

BLANK FIBREGLASS BOARD

Single sided copper clad, for making your own PCB's.

300mm x 300mm

Cat. HP-9510

ONLY $5.00 each
NORMALLY $8.95
SAVE $3.95

MINI BURGLAR ALARM

WHAT A FLOP!

We thought it would sell, but alas it didn't.

As an alarm you can use it to protect a garage, tool shed, holiday house, boat and sheds, caravan, video recorders, etc. Far more information on the alarm in our 1986 Catalogue.

Or, you can pull it apart and use the parts.

YOU GET:-

1 x Horn speaker (Arista brand) - Value $13.00
1 x Jiffy box - Value $1.85
1 x p/on switch - Value 55¢
1 x 3.5mm chassis socket - Value 55¢
14m of speaker cable + mini plug - Value $3.92
1 x Alarm circuitry + 9v battery clip - Value $4 and instructions

TOTAL VALUE $23.87 in parts

ALL THIS FOR ONLY

$10.00

Less than the price of the horn alone

WERE SELLING FOR $39.50

SILLY PRICES

GENUINE CANNON ISD RIGHT ANGLE SOCKET

NORMALLY $5.75 each
Cat. PS-0826

NOW ONLY $2 each

SILLY PRICES

TO-3 TRANSISTOR SOCKET

SILLY PRICES

Phenolic type
ONLY 10 for $1
NORMALLY 25¢ each
SAVE $1.50

RCA SOCKETS

Single socket
Mounted on bakelite with plug.
Cat. PS-0262
NORMALLY 36¢ each
20 for $1
THAT'S 5¢ ea

Twin RCA Socket
Mounted on bakelite with plugs.
Cat. PS-0263
NORMALLY 75¢ each
10 for $1
THAT'S 10¢ea

SILLY PRICES

SPEAKER TERMINALS

Spring terminal for easy connection.
NORMALLY 75¢ each
ONLY $1 for 5!
Cat. PT-3001
THAT'S 20¢ea

PLUG & SOCKET

A 3 pin line plug and chassis socket suited for low voltage or speakers, etc.
NORMALLY 90¢ each
ONLY 5pr for $1
THAT'S 20¢ea
Cat. PS-2092

4AA BATTERY HOLDER

Holds 4 penlight batteries. Suites many radios, etc.
Cat. PH-9200
NORMALLY 70¢ each
5 for ONLY $1
THAT'S 20¢ea

6AA BATTERY HOLDER

Holds 6 penlight batteries
NORMALLY $1 each
ONLY $1 for 4
THAT'S 25¢ea
Cat. PH-9206

SILLY PRICES

4½ DIGIT ACCURACY 3½ DIGIT PRICE!!

AND DIGITAL HOLD TO BOOT!

Just think a multimeter with 0.15% accuracy on most ohms ranges. 0.05% on DC volts and 0.5% MAX on DC current! STAGGERING. Plus, continuity buzzer and LED symbol, auto polarity, auto zero, vinyl case and DATA HOLD as well!! NOT TO MENTION the transistor and diode tester!!

SPECIFICATIONS:
◆ 0 - 1kV DC 0.05% ◆ 0 - 750V AC 0.8% (max) ◆ 10A DC 0.5% (max) ◆ 0 - 10A AC 1% (max) ◆ 20M ohm 0.5% (max)

FEATURES:
◆ All ranges fully protected ◆ Auto zero ◆ 0.5" high LCD ◆ Diode test (1mA fixed current) ◆ LCD display feature ◆ Functional annunciators ◆ Extremely accurate ◆ 20 page instruction manual included.
Cat. QM-1550

ONLY $159.00

ADD-ON ULTRASONIC DETECTOR FOR CAR ALARMS

Now you can really protect your car!
This unit is supplied with discrete looking ultrasonic transmitter and detector units in attractive moulded housing with mounting clip. The control box (which has a sensitivity adjust control) fits anywhere under the dashboard and runs from +12V. The output is either normally open or normally closed which will adapt to any existing car alarm with this facility. No soldering required. All screw connectors. Transmitters are tamper loop protected too!
About ½ the price of the 'name' brand ultrasonic detectors and JUST AS GOOD!
Cat. LA-5320

ONLY $49.95

300 WATT INVERTER WITH AUTO START

This is the built version of the EA September 1985 project!
Just think how handy it would be to have 240 volts AC mains power when camping, or for your boat or caravan - well this brilliant new design is the answer.

COMPLETE KIT VERSION
Cat. KA-1610

ONLY $229

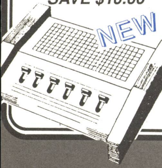
FULLY BUILT & TESTED
Cat. MI-5000

ONLY $289

VIDEO SWITCHING BOX

With this video switch you'll never have to unplug video cables again.
It has inputs for a TV game, VCR, and also an auxilliary input/output which can be used for a computer, satellite receiver, video disc or 2nd VCR.
It employs RF switching and has common 75 ohm sockets, same as your TV.
Cat. AV-6505

ONLY $39.95
SAVE $10.00



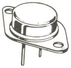
GORE HILL OPEN UNTIL 4pm SATURDAY

NEW MOSFETS

As used in the NEW AEM series 6000 poweramp.

2SJ56
Cat. ZT-2450
$13.95

2SK176
Cat. ZT-2455
$12.50



BARGAIN BAGS

BACK AGAIN

Each bag contains heaps of goodies for your junk box. Average weight is 1kg. Personal shoppers only.

ONLY $9.95

BARGAIN RF CHOKE

Heavily attenuates from 10MHz - 100MHz. Uses Philips Ferrocube bead with 3 turns of tinned wire. Will carry 2 - 3 amps so is ideal for in-line RF attenuators in power supply wiring.
Cat. LF-1200

$1.00 EACH

CHARACTER GENERATOR ROM

Works with both 6845 & 6545. Saves the user having to design and program his own character generator, with a total of 128 characters. It contains the full ASCII character set plus more. Supplied in a standard 2716 EPROM for easy interfacing. Eleviates the need for an EPROM programmer when combined with an SCR controller they form the basis of a low cost video display capable of displaying up to 130 columns x 30 rows.
Cat. ZZ-8456

ONLY $19.95

10 AMP DIGITAL MULTIMETER

WITH TRANSISTOR TEST FACILITY

Superb features and specifications. Includes 0.5" high digits, single function range switch, long battery life etc. Size 170(h) x 90(w) x 35(d)mm. SEE THE JAYCAR 1986 CATALOGUE FOR MORE DETAILS.
Cat. QM-1530

ONLY $89.95

BISHOP GRAPHICS

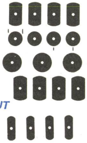
As demand for greater PCB density increases so does the need for a more professional approach to PCB design. To help in this regard, Jaycar stocks a comprehensive range of PCB artwork materials from ***BISHOP GRAPHICS*** of the USA. This material is both dimensionally stable and accurate, which enables you to produce complex layouts with greater accuracy (very necessary for LSI for example). Once your artwork has been produced, you can make your own board.

PRE-SPACED PADS

HG-9906	0.100" diameter 1.58mm 240 pads	$4.35
HG-9907	0.100" diameter 1.91mm 140 pads	$4.35
HG-9908	0.156" diameter 2.54mm 150 pads	$4.35

DIL PATTERNS

HG-9909	14 pin 32 symbols	$4.35
HG-9910	16 pin 32 symbols	$4.35
HG-9911	18 pin 28 symbols	$4.35
HG-9912	24 pin 12 symbols	$4.35
HG-9913	28 pin 12 symbols	$4.35
HG-9914	40 pin 8 symbols	$4.35



DIL PATTERNS - NARROW CUT

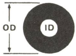
HG-9918	14 pin 32 symbols	$4.35
HG-9919	16 pin 32 symbols	$4.35
HG-9920	40 pin 8 symbols	$4.35

BLACK ARTWORK TAPE

HG-9930	0.026" wide x 20 yards	$3.15
HG-9931	0.031" wide x 20 yards	$3.35
HG-9932	0.040" wide x 20 yards	$3.35
HG-9933	0.050" wide x 20 yards	$3.35
HG-9934	0.062" wide x 20 yards	$3.50
HG-9935	0.080" wide x 20 yards	$3.50
HG-9936	0.093" wide x 20 yards	$3.50
HG-9937	0.100" wide x 20 yards	$3.50
HG-9938	0.125" wide x 20 yards	$3.50
HG-9939	0.200" wide x 20 yards	$3.50
HG-9940	0.250" wide x 20 yards	$4.75

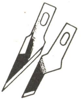
DONUT PADS

HG-9941	0.080" OD x 0.031" ID 96 symbols	$3.50
HG-9942	0.100" OD x 0.031" ID 96 symbols	$3.50
HG-9944	0.125" OD x 0.031" ID 96 symbols	$3.50
HG-9945	0.156" OD x 0.031" ID 96 symbols	$3.50
HG-9947	0.200" OD x 0.031" ID 108 symbols	$3.50
HG-9948	0.250" OD x 0.031" ID 128 symbols	$3.50



ARTWORK ACCESSORIES

HG-9955	X-ACTO KNIFE	$3.75
HG-9956	X-ACTO BLADES trim pk of 5	$3.50
HG-9957	X-ACTO BLADES art pk of 5	$3.50



RISTON PCB

HG-9970	127mm x 152mm	$5.50
HG-9972	152mm x 254mm	$10.50
HG-9974	254mm x 254mm	$21.50

SCOTCHCAL FILM

HG-9988	Black Aluminium 10" x 12"	$9.95
HG-9989	Red Aluminium 10" x 12"	$9.95
HG-9990	Red on white plastic 10" x 12"	$9.95
HG-9991	Black on white plastic 10" x 12"	$9.95
HG-9992	Blue on white plastic 10" x 12"	$9.95
HG-9962	Exposure film 10" x 12"	$7.95

DEVELOPERS

HG-9664	CCRD 30 developer 500ml	$4.25
HG-9968	Stripper CRS-40	$4.35
HG-9983	Negative photo resist CNR05	$6.10
HG-9981	Developer for positive	$3.50
HG-9984	Developer for negative	$8.90
HG-9966	8500 Scotchcal developer	$3.35

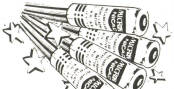
PC BOARD PRODUCTION ARTWORK

PENLIGHT NiCads

Don't keep wasting money buying throw-away batteries - step up to rechargeable NiCads.

SUPERB "ROCKET" BRAND
AA PENLIGHT 450mAh
Cat. SB-2452

$2.95 each
SPECIAL 4 for $10

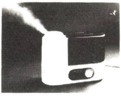


IT'S HERE ULTRASONIC AIR HUMIDIFIER

CREATE YOUR OWN CLIMATE

This unit re-humidifies air automatically by an ultrasonic mist evaporator. You can adjust the humidity in your environment in the range 30-90% R.H.!! It has a large water container (4.15 litres) and switches off automatically when dry.
Cat. YH-5520

ONLY $149.00



10 AMP DIGITAL MULTIMETER + TRANSISTOR TESTER & CAPACITANCE METER

The big daddy - this superb unit features 0.5" high digits, CMOS logic, auto polarity etc.
Cat. QM-1540

A BARGAIN AT
$129.00

SEE NEXT PAGE FOR STORE DETAILS

JAYCAR No.1 for the LARGEST range of ex-stock kits

Kit	Issue	Mag	Cat. No.	Price
CD Compressor	May 86	EA	KA-1665	$69.50
Electric Fence	Dec 85	EA	KA-1660	$45.00
UHF Converter	Apr 86	EA	KA-1642	$59.50
CD Adaptor	Apr 86	EA	KA-1645	$32.00
Remote for AM/FM Tuner	July 86	EA	KA-1636	$89.50
Video Fader	Jan 86	EA	KA-1626	$19.95
CD Attenuator	Jan 86	EA	KA-1624	$7.95
100W rms Mosfet Module	Oct 85	EA	KA-1622	$89.50
Pest Off Pest Repeller	Nov 85	EA	KA-1620	$44.50
Dwell/Tachometer	Sept 85	EA	KA-1612	$36.95
Car Stereo Amp 50 watts	Aug 85	EA	KA-1600	$189.50
40 watt 12 - 240V Inverter	Aug 85	EA	KA-1598	$89.95
Digital Capacitance Meter	Aug 85	EA	KA-1595	$79.95
House Alarm	Jan/Feb 85	EA	KA-1582	$119.50
30 volt Power Supply 1 amp	Jan 85	EA	KA-1574	$74.50
Electronic Crossover	Nov 84	EA	KA-1571	$89.50
20 watt Low cost amp module	Nov 84	EA	KA-1567	$22.95
Railmaster train controller	Sept 84	EA	KA-1560	$99.95
Railmaster diesel sound simulator	Nov 84	EA	KA-1561	$22.50
Railmaster steam sound simulator	Dec 84	EA	KA-1562	$22.50
Railmaster walk around	Sept 84	EA	KA-1559	$11.95
CQAM stereo decoder	Oct 84	EA	KA-1555	$26.50
Deluxe car burglar alarm	May 84	EA	KA-1550	$79.50
Ignition killer	Feb 84	EA	KA-1535	$23.50
Motorcycle intercom	Feb 84	EA	KA-1533	$43.50
Video amp/buffer	Aug 83	EA	KA-1527	$18.50
Guitar effects BBD	June 83	EA	KA-1522	$99.00
Touch light dimmer	Apr 83	EA	KA-1508	$27.95
Transistor assisted ignition	Jan 83	EA	KA-1506	$39.95
TAI breakerless T.A.I.	Dec 83	EA	KA-1505	$43.50
Hall effects interface TAI	Dec 83	EA	KA-1504	$6.95
Siemens hall effects interface	Sept 84	EA	KA-1503	$6.95
Playmaster 200 watt amp	Feb 85	EA	KA-1500	$449.00
Fluoro starter	Oct 82	EA	KA-1480	$6.50
Subwoofer amp	July 82	EA	KA-1452	$119.95
Vocal canceller	Apr 82	EA	KA-1430	$23.50
Function generator	Apr 82	EA	KA-1428	$119.50
Dual tracking power supply	Mar 82	EA	KA-1410	$119.50
Metronome	Jan 82	EA	KA-1400	$19.50
50MHz Frequency counter	Dec 81	EA	KA-1390	$149.50
Prescaler to 500MHz	Dec 81	EA	KA-1392	$35.00
Transistor tester	Aug 83	EA	KA-1119	$19.95
300 watt amp module	June 80	EA	KA-1115	$99.95
Power supply for above	July 80	EA	KA-1116	$99.95
Speaker protector for above	July 80	EA	KA-1117	$15.95
Electric fence	Sept 82	EA	KA-1109	$19.95
Musicolor 4	Aug 81	EA	KA-1010	$99.90
Speech synthesiser	Feb 86	AEM	KM-3042	$39.95
Dual speed modem	Dec 85	AEM	KM-3040	$169.00
Ultra fidelity preamp	Oct 85	AEM	KM-3030	$289.00
8 channel relay interface	Oct 85	AEM	KM-3028	$44.50
Courtesy light extender	Nov 85	AEM	KM-3025	$11.50
Listening post	July 85	AEM	KM-3015	$37.50
120 watt Mosfet module	July 85	AEM	KM-3012	$69.50
60 watt Mosfet module	July 85	AEM	KM-3010	$55.00
FM transmitter - mini	Dec 85	ETI	KE-4711	$39.95
D.I. Box ETI 1401	Sept 85	ETI	KE-4708	$39.95
4 sector home alarm	May 85	ETI	KE-4698	$26.95
C.D.I. ETI 342	Feb 85	ETI	KE-4690	$79.50
Car alarm ETI 340	Apr 84	ETI	KE-4678	$75.00
RS232 to Centronic interface	Jan 84	ETI	KE-4666	$29.95
+/- 15 volt power supply	June 77	ETI	KE-4405	$25.50
150 watt Mosfet module	Mar 82	ETI	KE-4220	$98.50
100 watt Mosfet module	Jan 81	ETI	KE-4210	$75.00
ETI 5000 1/3 graphic equaliser	Nov 82	ETI	KE-4204	$209.00
ETI 5000 preamp	June 81	ETI	KE-4202	$339.00
ETI 5000 power amp	Jan 81	ETI	KE-4200	$399.00
ETI 480 100 watt module	Dec 76	ETI	KE-4052	$29.50
ETI 480 50 watt module	Dec 76	ETI	KE-4050	$25.00
ETI 480 power supply	Dec 76	ETI	KE-4048	$25.00
Temperature probe DVM	July 83	ETI	KE-4033	$25.50
NiCad charger	Mar 83	ETI	KE-4029	$14.95
Signal speaker protector	Oct 82	ETI	KE-4023	$19.95
Mixer preamp	July 80	ETI	KE-4014	$37.50
Microwave leak detector	July 79	ETI	KE-4013	$17.95
12 volt flasher	Dec 79	ETI	KE-4012	$8.95
2010 graphic equaliser		JC	KJ-6535	$159.00
2801 1/3 octave equaliser		JC	KJ-6531	$225.00
Negative ion generator		JC	KJ-6511	$49.50
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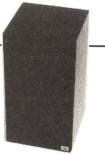

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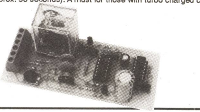

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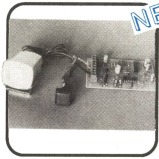

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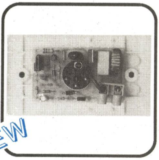

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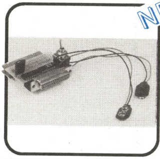

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Inside the OSCILLOSCOPE PT.2

The differences between oscilloscopes can be found in their specifications and features. This article describes the characteristics that affect performance.

by MARGE GUSTAFSON, LARRY JOHNSON & CARL LARON

Examine the catalogs of any test-equipment manufacturer or distributor and you will find a multitude of different oscilloscopes. The reason for that, of course, is that each oscilloscope is better for some particular application than others. At one end of the scale, you'll find the inexpensive "hobbyist" models that are suitable for occasional workbench use. At the other end, you will find the multi-thousand dollar laboratory models. The differences between them are features and specifications. But what are those features and specifications, and which ones are most important in determining which scope is right for you? We will answer those questions for you in this article.

Bandwidth

The most basic oscilloscope specification is vertical bandwidth. When deciding between scopes, that specification is your best indication of whether or not a particular scope is suitable for your application.

The vertical amplifier of an oscilloscope is designed so that its frequency response remains more or less the same until it reaches some point, known as the 3dB, or half-power, point. At that point, the displayed vertical signal is down 3dB (or at −3dB) with respect to a low-frequency reference voltage (see Fig.9). At frequencies higher than the 3dB point, the oscilloscope's response will roll off at a rate of approximately 6dB-per-octave.

Oscilloscopes that have a roll-off that is considerably higher than 6dB-per-octave will have trouble reproducing the high-frequency components of complex waveforms. Those with a roll-off rate that is considerably lower than 6dB-per-octave will suffer from overshoot on pulse signals.

It is obvious that the wider the bandwidth the more versatile the oscilloscope. Also, it is obvious that the wider the bandwidth, the more expensive the oscilloscope. That is so because it is expensive to produce a vertical amplifier that has nearly flat response across a wide bandwidth. Thus, unless you have money to spare, it pays to consider carefully how much bandwidth you really need. For general experimentation, or occasional TV or audio equipment troubleshooting, a bandwidth of 15MHz or so should suffice. If you regularly service video equipment, or work with digital equipment, a higher bandwidth will probably be needed.

Comparing oscilloscope bandwidth ratings is not always as simple as it should be. That's because all manufacturers do not quote the specification in the same manner. While most use the 3dB point as the upper bandwidth limit, some use 3.5, 4 and even 6dB. While the specification might be accurate, a bandwidth that is specified as being 4dB down at 50MHz is not the same as one specified as 3dB down at 50MHz. Use of non-standard specifications can stretch the bandwidth by 50%, or even more.

When working with computers, or other digital equipment, a second specification, closely related to bandwidth, becomes important. That specification is *risetime*. Risetime is defined as the period required for the leading edge of a pulse to rise from 10% to 90% of its ultimate level (see Fig.10). It is related to bandwidth as follows:

$$T_R = 0.35/f$$

where T_R is the risetime in microseconds, and f is the bandwidth in MHz.

To examine short-duration pulses, such as the rapidly changing digital logic-levels within a computer, you need a scope with a wide enough bandwidth to display those pulses without distortion. For example, to see pulses with 5-nanosecond (ns) risetime, an oscilloscope with a 70MHz bandwidth is re quired (0.005 = 0.35/f; f = 0.35/0.005 = 70).

Oscilloscopes come with vertical am plifiers that are AC coupled, via coupling capacitor, or both AC and D coupled (no coupling capacitor). Th chief difference between the two is tha the DC component is filtered out whe the scope is used in the AC mode. Generally, all but low-cost units offer bot coupling modes.

When operated in the AC-couple mode, the oscilloscope will have a upper 3dB point determined by th vertical-amplifier's frequency respons and a lower 3dB point that is deter mined by the low-frequency reactanc of the coupling capacitor. That lowe 3dB point is generally between 2-10Hz In addition, in the AC coupling mode the peak input must be specified. Tha peak input is typically 400-600 volts A plus DC.

Oscilloscopes that offer both AC an DC coupling have an input mode selec tor switch. This will usually have third position labelled "ground". Thi position disconnects the vertica amplifier from the input connector an simultaneously grounds the input to tha

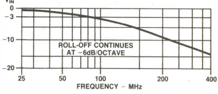
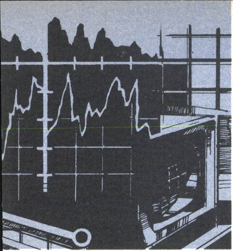


Fig.9: the vertical amplifier of an oscilloscope is designed so that its response i reasonably flat to a point known as th 3dB point. That point defines the oscilloscope's bandwidth.



This article originally appeared in "Hands-On Electronics", Vol.2 No.5, and appears here by arrangement.

amplifier. This setting allows the 0-volt position of the trace to be noted.

Sensitivity

Almost as important as bandwidth is the specification known as *input sensitivity,* or *deflection.* This specification refers to the minimum signal voltage required to produce a usable deflection on the scope's CRT display. Generally, this deflection is defined as one graticle division (usually 1cm).

As should be obvious, a scope with a sensitivity specification of 2mV/cm is more sensitive than one with a sensitivity of 5mV/cm. But sensitivity specifications are given in both peak-to-peak (p-p) and root-mean-square (rms) voltages. There is a significant difference. To make a meaningful comparison, you can convert rms to p-p by multiplying the rms rating by 2.8. For example, a scope rated at 2-volts rms would be rated at 5.6-volts p-p (2.8 x 2). Thus, a scope rated at 2-volts rms is not as sensitive as one rated at 5-volts p-p (5.6- vs. 5 volts).

Bear in mind that it is difficult to do any meaningful analysis of signals that are only one divison high. Usually, you will want the signals to be at least two divisions in height; four divisions of height will allow you to see most signal details. On the other hand, the higher the sensitivity, the more expensive the scope.

You can determine the sensitivity of the scope by looking at the vertical amplifier control. The lowest setting on that control is the vertical sensitivity of the oscilloscope. If the scope has a vertical magnifier, divide that lowest setting by the magnification factor. Thus, an oscilloscope that has a minimum setting of 5mV/cm, and a 5 x magnifier, has a minimum sensitivity of 1mV/cm.

Input impedance

For almost all applications, an oscilloscope with a high input impedance is desirable. That prevents the oscilloscope from affecting the circuit that it is being used to test. These days, almost all oscilloscopes have an input impedance of one Megohm (one-million ohms).

Triggering

Most sophisticated oscilloscopes provide several trigger options to make the unit more versatile. Those options include positive- or negative-slope triggering, triggering level, trigger signal source (external, internal, power-line, etc), and more.

As with the vertical amplifier, sensitivity and bandwidth are used to describe trigger circuitry performance. Generally speaking, sensitivity should be sufficient to allow a stable trace of one division or less to be displayed. Trigger bandwidth defines the highest frequency that can be displayed with any degree of stability at the oscilloscope's minimum deflection. That specification determines the ability of an oscilloscope to trigger on complex waveforms, and the stability of the display of such waveforms. Generally, the trigger bandwidth should be at least as wide as the vertical bandwidth. Anything less than that will provide unacceptable results when viewing complex waveforms. On the other hand, a trigger bandwidth of twice the vertical bandwidth will provide outstanding results.

Features

As important as specifications are, it is often the features that make an oscilloscope either suitable or unsuitable for a particular application. Let's briefly go over some of those features and their use.

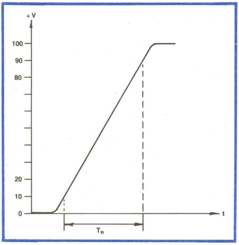


Fig.10: risetime is defined as the time it takes for a pulse to go from 10% of its ultimate value to 90% of that value.

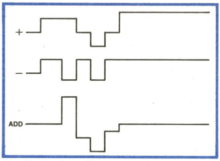


Fig.11: in the add mode, the two channels are added together algebraically. If one of the channels is inverted, that mode is useful in comparing the two input signals.

Last time, we looked at the two methods oscilloscopes use to display two simultaneous traces — alternate and chopped. In addition, all dual-trace scopes are capable of displaying only one channel at a time.

More sophisticated oscilloscopes offer yet another option, called *add.* In this mode, the two signals are added algebraically, and displayed as a single trace. Most often, oscilloscopes equipped with this option also provide a control that allows you to invert the polarity of one of the traces. When that is done, and the signals are added, the parts of the signal that are common to both inputs are not displayed — only the parts of the signal that are different are seen (see Fig.11). This allows for easy comparison of the inputs.

Voltage calibrators are found on many oscilloscopes. They provide the user with an easy way to check the accuracy of the oscilloscope's vertical amplifier and permit compensation of the probes. (If probes were ideal, no such compensation would be needed. However, real probes have some capacitance that can cause distortion of the displayed waveform. As a result, most oscilloscopes use probes that have a compensation adjustment to counteract that effect.)

If you expect to see the fine details of the display, you need a trace that is as sharp as possible. A trace that is unacceptably thick can hide such things as ringing and overshoot. Most scopes have adjustments that are used to control the characteristics of the trace. Those are focus, intensity, and astigmatism. The purpose of the first two of those is self explanatory. The astigmatism control is used to shape the beam into a perfectly round dot.

Most oscilloscopes have controls that allow you to adjust the horizontal and vertical position of the traces. Units without such controls have limited versatility. You should also be sure that those controls allow you to position either trace anywhere on the screen.

Most dual-trace oscilloscopes offer an X-Y mode. In this mode one channel serves as the horizontal channel. This allows you to use a triggered scope in the same manner as an older recurrent-sweep oscilloscope with separate horizontal and vertical inputs and is useful for examining Lissajous figures, phase differences, vectorscope displays, etc.

As we saw last time, the graticle is the grid that is placed on the face of the CRT. But how that grid is placed there can sometimes affect the accuracy of the oscilloscope. If there is any space at all between the graticle and the face of the CRT, a considerable parallax error can be introduced. Because of that, the graticle must be placed as close to the face of the CRT as possible. In addition, a parallax error can even be caused when the graticle is placed directly on the face of the CRT. This error is caused by the thickness of the glass itself. (Remember, the display is generated by exciting phosphors that are located on the inside surface of the glass). Thus, the most accurate displays are obtained on oscilloscopes that have their graticle etched on the inside surface of the glass. However, such tubes are expensive.

To make the lines of the graticle stand out, some more expensive oscilloscopes offer an illuminated graticle. There are many methods through which that can be achieved. One is simply to flood the graticle with light. A better method is to illuminate the edge of the graticle. On graticles where the lines have been etched rather than printed, this method will result in a very uniform display.

Delayed triggering, or gating, allows you to observe, in a horizontally expanded format, only the portion of a waveform that is of interest. It does so by delaying the triggering of the scope until a particular point in the waveform is reached. Thanks to the inclusion of a display intensifier, or marker, use of delayed triggering is fairly easy on most scopes. The latter is used to mark the portion of the waveform that is of interest. Once that is done, the delay time, which is actually the timebase you wish to use to view the selected portion of the waveform, is chosen. You then activate the delayed triggering option and the display opens up and shows the selected portion of the waveform in detail.

The above are some of the more basic oscilloscope features; there are, of course, many more. Some oscilloscopes include built-in DMMs. Others offer on-screen alphanumeric readouts (see Fig.13), colour displays, the capability to store traces in memory, multiple-trace (4, 8, or even more) displays, and just about anything else you can think of. Some of the newest oscilloscopes are even using digital signal-processing techniques. In such a scope, a measured trace can be manipulated and displayed in an almost unlimited number of ways. Unfortunately, those oscilloscopes are prohibitively expensive at present for most applications.

Now that we know how an oscilloscope works, and what its various specifications and features mean, it's time to learn how to use one to its best advantage. This will be the subject of our final article next month.

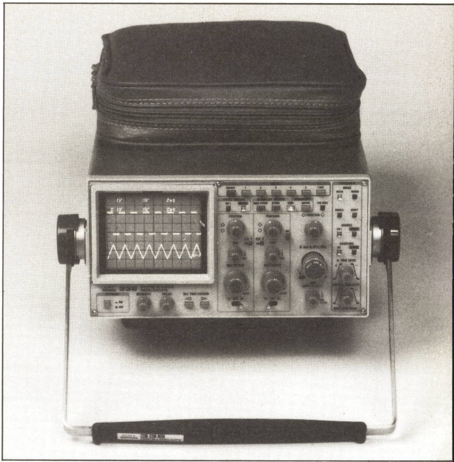


Fig.12: the Tektronix/Sony 1336. This scope features an on-screen alphanumeric display and digital trace storage.

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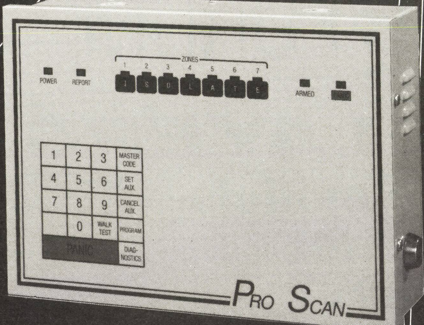

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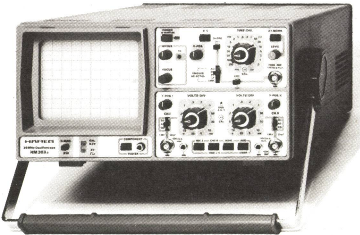

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FORUM

Conducted by Neville Williams

CD PLAYERS

Do some models sound better than others?

In a disarmingly pleasant way, a reader from Queensland invites me to discuss a subject which he feels should prove "both topical and provocative" — an understatement if ever there was one. Whichever way I respond, I am sure to raise somebody's hackles, as happened with "Utopiatronics" in the May issue.

His letter opens with an appreciative word and a pat on the back, followed by an unmistakeable shove:

I would like to express appreciation for your "Forum" column, which I have enjoyed for more years than I care to count. The thought-provoking matters raised and the arguments presented I have found both educative and stimulating.

Here is a subject you might care to discuss in your column; I am sure that readers will find it both topical and provocative.

What an agreeable person (I mustn't say "man"); and a way with words, too! What follows could reflect genuine puzzlement, lucidly expressed, or a "line" with a baited hook!

Why are we led to believe that all CD players reproduce music to the same level of accuracy and acceptability? Reviews quote the usual technical details: frequency response, distortion levels and so on. But surely the prime requirement is an accurate analog signal from digital information under a variety of conditions.

Strings appear to be the main problem, possessing complex waveforms that present significant difficulties when an attempt is made to reconstruct them.

From my listening tests, and from discussions with selected and apparently knowledgeable dealers, it appears that one brand of player is better than all the others at producing quality sound, though it offers little else for its substantial price tag. A couple of others are good performers and are followed at intervals by the rest of the field, all providing acceptable sound, or so we are told.

Yet reviewers continue to quote technical specifications and operating features rather than telling us how they actually sound.

How do the terms "decoding chip", "oversampling", "filtering" and "correction circuitry" relate to the quality of the resultant analog signal?

I do hope that you can provide some characteristically revealing comment on this confused issue.

R.L. (Oxford Park, Qld).

I should perhaps mention that R.L's letter was written earlier in the year but, as sometimes happens, it had to be held over for a couple of months, by reason of other commitments. In fact, that may not be a bad thing because, with the CD scene changing so rapidly, our response can take in aspects which were less apparent then than now.

It seems incredible that, less than four years ago, I was having to scratch around, here and overseas, to assemble sufficient basic information to present a series of introductory articles to the system in the February-March 1983 issues.

My initial reaction, and that of most readers, was one of incredulity at the way-out nature of the technology. The mind still boggles at the idea of an information spiral of such microscopic dimensions that sixty optical CD "tracks" can fit into the space occupied by a single groove in an LP recording; or thirty tracks into the width of a human hair!

How could equipment working to such dimensions ever be mass produced, especially at an affordable price? And how could it be anything but vulnerable and unreliable in the hands of everyday users?

CD was dismissed by many as an example of technology gone mad — a system doomed to failure or, at best, one that would have to struggle for many long years to make any impression on the solidly entrenched "black" disc.

Rapid acceptance

Those early reservations seemed to be borne out by massive rejection rates in compact disc production. Now, a mere three years later, the same factories face a quite different problem in not being able to keep up with the ever-increasing demand for their product. And record companies, which decided to wait and see, have been left with egg on their corporate faces.

CD players are also being mass produced in huge numbers, apparently without undue difficulty, and have been marketed in Australia for as little as $300 for a known brand unit — despite our deflated dollar.

Having in mind the likely performance of even budget priced CD players, a few hundred dollars is a modest outlay compared with what one can spend on a phono deck with lesser specifications.

For me, the impact of the CD system on the Australian market was highlighted when preparing the recent articles on phono players. In discussing hifi systems with one prominent distributor, I was told that a hi-tech phono deck was no longer an automatic inclusion in their up-market rack mounted systems. More often than not, a CD player was the preferred option.

Said the sales manager: "If a phono deck is required, the client is inclined to opt for a modestly priced unit, purely to retain the ability to play black discs, if necessary."

Legitimate technology?

Practicalities aside, the main concern of hifi devotees has been whether digital technology is a legitimate method of recording and reproducing quality sound. Intuitively, it seemed all wrong, and they have said as much, frequently and loudly.

This thought is undoubtedly behind R.L's proposition:

"But surely the prime requirement is the reproduction of an accurate analog signal from digital information under a wide variety of conditions. Strings appear to be the main problem, possessing complex waveforms that present significant difficulties when an attempt is made to reconstruct them."

Unless I am much mistaken, R.L. sees the "reconstruction" of analog waveforms as a questionable process, peculiar to the digital system; with complex information (eg, strings) it is inherently difficult to reconstitute the kind of "accurate" analog signal which we need and to which we are accustomed.

This would seem to be an appropriate point to take up R.L.'s invitation to "provide some characteristically revealing comment on this confused issue".

Let me put to R.L. a question that, I recall, arose on a previous occasion: When was the last time that he listened to the reproduction of **any** analog signal — let alone an "accurate" one? It would certainly not have been from:

- A so-called "analog" tape, because the remanent flux pattern on the tape is an integrated resultant of spikes or "samples" at the bias frequency, typically 70-80kHz.
- A so-called "analog" disc, because nearly all discs are transcribed in the first instance from a tape master.
- Radio, because the recovered audio is reconstructed in the receiver from a sampling process involving the carrier and stereo multiplex frequencies (in the case of FM-stereo).

That leaves a handful of limited edition, direct cut-stereo LP discs as the only accessible source of sound recorded in pure-non-reconstructued analog form.

In saying this, I am not making a special case for direct-cut discs, nor am I trying to belittle tape, black discs or radio. I am simply making the point that virtually all the reproduced music we listen to is pseudo-analog which has been "reconstructed" from information samples by processes that — if measurements mean anything — are less elegant than modern digital sampling.

R.L.'s lines of demarcation may need to be redrawn!

Orchestral strings

I am not sure whether his remarks about strings were prompted by our own recent observations on the subject but, if so, they too are somewhat misplaced.

The point we were seeking to make, since supported by people who should know, is that massed orchestral strings and massed choral voices can sometimes sound "distorted" at an actual performance, whether or not a recording is made.

The apparent explanation is that a multiplicity of independent sound sources, nominally in unison but marginally out of tune with each other, can create a mass of potential, random low frequency beats, sensed as "edginess" and "congestion", and essentially similar to intermodulation distortion in a recording or amplifier system.

The problem increases with the number of sound sources, the degree of disharmony and the effect of unsuitble acoustics, leading to the conclusion that some performances by some ensembles in some venues are likely to sound "cleaner" and less "congested" than others — whether heard "live" or per medium of a recording.

I don't go along with R.L.'s suggestion that orchestral strings are especially at risk with a digital system. It would be nearer the mark to suggest that massed orchestral strings or massed choral voices are especially vulnerable to any recording or any reproduction system which exhibits a significant order of intermodulation distortion.

Having listened to, and reviewed, numerous digitally-sourced recordings since they were first released in the late '70s, my own impression is that they compare more than favourably with those recovered ("reconstructed") from bias-based remanent flux on a so-called "analog" tape master.

Those reviews?

And that brings us to the core of R.L.'s letter: why do equipment reviewers have a lot to say about facilities and specifications — all of which follow a pattern — and very little about the alleged subtle differences between CD players, which make one better than another at "producing quality sound"?

Okay, let's think about it.

In the BCD (Before Compact Disc) era, when available signal sources exhibited fairly obvious aberrations in terms of frequency response, distortion and noise, it was not unduly difficult for reviewers to come up with a comprehensive objective and subjective reaction to a new product.

They could react to its presentation and specifications, measure its performance, listen to the end result and hopefully point up a logical relationship between the measurements and the sound. To me, the most helpful reviews fol-

From 78s to CD!

While current model CD players and high quality compact discs can bring the finest ever sound into the home, the rapid adoption of CD as an all-purpose system is prompting the transfer of older but interesting recordings to the new format.

Musically important classical performances from the LP era are no surprise but they have now been joined by memorable jazz recordings from the '20s and '30s, re-processed by Australian engineer Robert Parker, from original 78rpm shellac pressings.

Using the latest digital technology, as described in our September '84 issue, to add ambience and dimension, and reduce surface noise, the reprocessed recordings proved highly successful on LP. They are now being made available on compact disc.

lowed that general pattern.

However, some reviewers and commentators have chosen to scorn measurements, rely on their own "golden ears" and, as often as not, express their likes and dislikes in grossly exaggerated — and technically imprecise — terms. It burnishes their ego, I guess, and provides diverting copy for the impressionable.

Compact disc players have drastically altered the rules of the game, although some seem not to have noticed.

Thanks to the digital technology, the level of performance has been substantially lifted, with frequency response, distortion, signal/noise ratio, channel separation, &c, far more uniform, model to model, and deck to deck, than was ever the case with analog equipment.

The simple truth is that CD players to date have been sufficiently good and sufficiently uniform to make it very difficult indeed to pick and choose on sound alone. What's more, practical, technically-aware reviewers realise that, in everyday use, the ultimate quality will be determined, not by the player, but by the source recording and the remainder of the reproducing chain.

But that doesn't suit, nor does it deter, those who delight in over-statement. Perhaps I should add: "or some who write advertising copy". They still profess to discover startling, manifest and important differences in sound quality — and thereby lead (or mislead) others to expect them.

Real or imaginary?

I am not denying that there may be sonic differences between some CD players. What I am suggesting is that, in reality, they are far more subtle and elusive than is often claimed, to the extent that few listeners would ever be aware of them.

If you think that I'm "sticking my neck out" in saying this, I refer you to an article in "Stereo Review" magazine for January 1986 entitled "Do all CD players sound the same?"

Aware of the interest in this latest hifi faction fight, the editors sought an answer with rigorously designed and controlled tests organised by David L. Clark, originator of the ABX Comparator system. The two-day tests were conducted in an IEC (provisional) standard listening room at DLC Design in Michigan, USA, and involved eleven members of a Detroit based audio-hifi group, all of them experienced listeners.

In the ABX system, two devices under test, A & B are compared by the listeners to a reference, which they select at will by pressing buttons. In fact, the "reference" is either A or B, selected randomly at each switching by a computer. Each time a button is pressed, the listener **must** decide whether its sound matches that of A or B and **must** register a vote accordingly.

Neither listeners nor operators know which device is in use at any instant so that the tests are completely "double blind". It is left to the computer to register and tabulate the correct and incorrect verdicts.

If there are discernible differences between the devices under test, they will be apparent as a statistical predominance of correct verdicts, indicating that a valid basis exists for listeners to express a preference for one or the other — for whatever reason. On the other hand, a statistically random result indicates that the listeners were guessing and that there is no reliably discernible difference.

Essential precautions

According to the Author, the levels had to be precisely balanced before each set of tests (presumably on white noise) because it was found that a loudness margin of even 0.2dB was enough to make a player sound "better"!

As a further precaution, the players being tested were maintained in exact note-by-note synchronisation by using an external time clock to keep one of them in step with the other. This was to forestall any possibility of a signal lead or lag prompting educated guesses.

In all, twenty tests were performed on each of six CD players from exotic to economy models and using recorded material ranging from impulse signals, through white noise to selected music.

The results were detailed in the original article but the overall conclusion is what matters in the present discussion. Differences were discernible (just) between some of the players with impulse signals and with low-level white noise. With music, the computed scores ceased to be statistically conclusive.

This observation held true, incidentally, for the Carver DTL-100, as reviewed in our January '86 issue. Without the so-called "time lens" in circuit (I quote): "the differences, if any, were very difficult to detect". With the Time Lens switched in, differences became apparent, because of the deliberately modified compensation.,

In the light of this, John Clarke's review of the Carver in EA would seem to have been "spot on".

One other observation, attributed to David Clark, caught our eye. Examination of the printout failed to reveal any one listener inarguably more perceptive than the rest. Either there were no "golden ears" in the group, or they all answered to that description!

Present implications

The "Stereo Review" article will certainly not be the last word on the subject. It covered only six models and, while they were selected to be representative, the findings on some other models might have uncovered differences attributable to aspects of the decoding mentioned in R.L's letter.

Again, cheap — and nasty — models might conceivably turn up in the future which could fail to live up to expectations.

But what we have in front of us, right now, is evidence that, deprived of extraneous clues and required to produce acceptable statistical evidence, a panel of eleven experienced hifi devotees failed to identify more than, at most, fleeting differences between six representative CD players.

It supports the position of a reviewer who hesitates to do more than rate the sound as "well up to the standard expected of a CD player," knowing that to make or imply comparisons calls for facilities and procedures rivalling those described above.

Conversely, it does nothing for the credibility of others, including R.L's "selected and apparently knowledgeable dealers" who, without cognisance of problems and precautions, boldly assert what an expert listener group in the USA were not able to establish under controlled conditions.

Does that mean that expensive CD players are a dubious investment? To an impecunious devotee who can get by without functional frills, they possibly could be. But there are any number of enthusiasts who simply cannot be content with equipment which might just miss out on some elusive subtlety or fall foul of some hypothetical hazard.

That's probably what's behind the closing remark in the "Stereo Review" report: "The main conclusion seems to be that audible differences do exist but they don't matter, unless you think they matter!"

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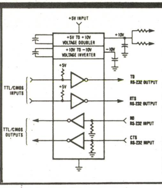

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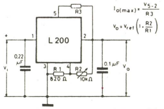
L 200
R3
5
1
2
3
4
R1
820 Ω
R2
10kΩ
0.22 μF
0.1 μF
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V_i
V_o
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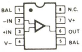

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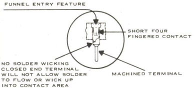
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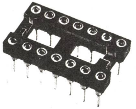

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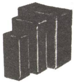

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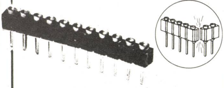

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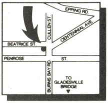

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Protect the bearings in your turbocharger

Turbo engine cool-down timer

Got one of those new turbocharged cars? If so, you need this project. When the ignition is switched off, it keeps the engine running for approximately 90 seconds to stop the turbocharger from overheating. A temperature sensor ensures that the circuit operates only when the engine reaches a preset temperature.

by COLIN DAWSON

Just about every car manufacturer presently has a turbocharged model or is planning to release one. In the last five years, this accessory has undergone a huge amount of development, having evolved from a strictly mug-lair "bolt-on" to a factory option for otherwise conservative machines.

So what exactly is a turbocharger? For those unfamiliar with automotive technology, it's basically a turbine-driven axial compressor.

The axial compressor forces air dow the throat of the carburettor (or mani fold in the case of fuel injection) an thereby increases the mass of petro air mixture fed to the engine so tha more power is delivered. The turbine for its part, is driven by the exhaus gases from the engine.

Although turbochargers seem to hav most of the bugs ironed out these days there are still some operating limita tions. One of the most important is t idle the car for a minute or two befor switching off. Without this precaution the turbocharger bearings can overhea and fail prematurely.

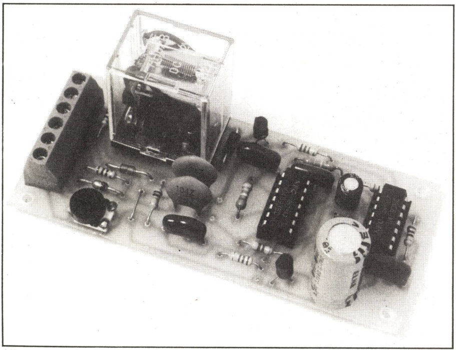
The problem arises because the com pressor rotor operates at very high tem peratures when the turbocharger is sup plying boost. Now although the rotor i designed to withstand these high tem peratures, the bearings are much more vulnerable. It is important that they no be allowed to get too hot.

This doesn't happen under normal operating conditions because oil circulation keeps the bearings cool. But if the engine is switched off immediately afte a heavy load, heat continues to transfe from the rotor to the bearings. Since there is now no oil flow, the bearings can quickly overheat and become fatigued.

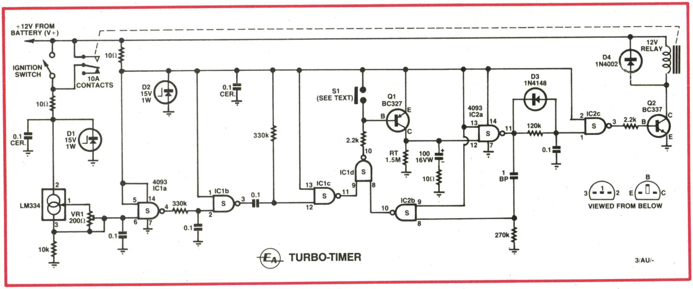
Cool it

During idling periods, and when the engine is not otherwise under load, a 'waste-gate' allows the exhaust flow to bypass the compressor, and so the rotor temperature is greatly reduced. This then is the reason why manufacturers recommend that turbocharged cars be idled for a minute or so before switching off — it gives the rotor time to cool and thus minimises heat transfer to the bearings.

The problem is many drivers forget about this cool-down time, at least until they are confronted with the expense of



All the parts are mounted on a small PCB which is installed under the dashboard.


TURBO-TIMER

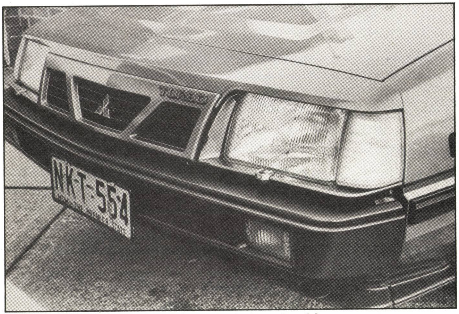
replacing the turbocharger. That's where the Turbo-Timer comes in — provided the engine has reached operating temperature, it automatically extends engine operation after the ignition is switched off.

Note, however, that the Turbo-Timer is not a device that allows you to leave your car while the engine is still running. You must remain with the car until the engine cuts out so that you can secure the car properly. In the case of a manual car, this means leaving the transmission in either first or reverse gear.

Put simply, the Turbo-Timer is a device that ensures that the proper cool-down period is observed at the end of a journey. It is designed for those cars which are not supplied with an automatic cool down timer as standard equipment and will suit just about any turbocharged model.

Although it added somewhat to the circuit complexity, we thought it important that the circuit should not require any changes to the car's wiring. The main problem in implementing this philosophy was this: to trigger the circuit, the ignition must be switched off, producing a +12V to ground transition at the input. Since the same effect is ostensibly produced when the timer cuts out, the circuit must be able to trigger on the first transition but ignore the second.

Another requirement was that a circuit failure must not result in engine failure. Our circuit easily meets this requirement. No matter how drastic the circuit failure may be, it cannot possibly stop the engine from running.



The circuit can be fitted to just about any turbocharged model.

Temperature sensor

In designing the circuit, we also had to consider situations where the Turbo-Timer would not be required.

Firstly, there's the situation where you've just been for a drive down to the corner shop. The engine hasn't even come up to operating temperature and certainly doesn't need a cool down period. A temperature sensor, mounted on or near the radiator, takes care of this contingency.

Another situation where the timer is unnecessary is after a slow drive through heavy traffic. The turbocharger will not have been doing any work and, again, doesn't need to be cooled. Because the engine will certainly have reached operating temperature in this instance, a manual defeat switch has been included. All you have to do is push the switch as the ignition is switched off.

Circuit Description

As you might expect, the circuit has a relay which bridges the car's ignition switch. Normally, the contacts of this relay are open, but during timer operation the contacts are closed. The rest of the circuit, ultimately, controls the relay.

What happens is that the circuit senses when the ignition is turned off. Then, if the engine has reached a preset temperature, it restores ignition by closing the relay contacts some 30ms later. While this may cause the engine to miss a couple of beats, it is short enough to ensure that it keeps running.

The circuit is based on two CMOS ICs with an LM334 used as the temperature sensor. The LM334 is fixed to the radiator cap or to some other convenient part of the radiator. Its output is monitored by IC1a which triggers when the voltage on its pin 6 input reaches a critical level (about 7V, depending on the particular IC).

The LM334 is actually a 3-terminal adjustable current source. It can be set up to provide a current output which is in proportion to absolute temperature. Although this particular device is only guaranteed over the range 0 to 70°C, it can be used for temperatures exceeding 100°C with some loss of linearity.

For the present application, linearity is of no consequence so, in view of its low price, the LM334 is quite suitable.

Current passing through the LM334 produces a voltage across the associated 10kΩ load resistor. This becomes the output voltage and varies in proportion to temperature. The trimpot connected across pins 2 and 3 is used to calibrate the LM334 and allows the trigger voltage (approx. 7V) to be set for a wide range of temperatures.

The output of IC1a (pin 4) is normally high but goes low when the critical temperature is reached. This low is fed to pin 2 of IC1b by a 30ms delay circuit which prevents spurious signals from triggering the circuit. In other words, the trigger signal must be longer than 30ms in order to trigger IC1b.

What all this means in practice is that, when the engine reaches operating temperature, the output of IC1b goes high. The circuit is now armed.

Assume now that the ignition is switched off. When this happens, current through the LM334 ceases, pin 6 of IC1a goes low, and pin 3 of IC1b also goes low. This low is fed into a differentiator (0.1μF and 330kΩ) to produce a 0.5ms pulse which is then gated through by IC1c and IC1d to the base of PNP transistor Q1.

Q1 thus turns on for 0.5ms and completely charges the 100μF timing capacitor on its collector via a 10Ω resistor. When the transistor subsequently turns off, the 100μF capacitor immediately begins discharging via the 1.5MΩ timing resistor (RT). This gives a timing period (and thus a motor run-on time) of approximately 1.5 minutes.

During the discharge time, both inputs of IC2a are high, its output (pin 11) is low, and thus pin 1 of IC2c is pulled low via D3. This, in turn, means that pin 3 is high and so Q2 and the relay are on.

Thus, at the beginning of the discharge time (ie, just after the ignition is switched off), the relay switches on and supplies power to the ignition circuit via the closed relay contacts.

If, however, S1 is pressed as the ignition is switched off, the base of Q1 is held high and so the transistor is held off. This prevents the circuit from triggering and so the engine switches off in the normal manner.

At the end of the timing period, pin 11 of IC2a switches high again. D3 is now reverse biased which means that there is a brief delay before pin 1 of IC2c switches high due to the time constant formed by the 120kΩ resistor and the 0.1μF capacitor. This prevents the relay from dropping out for approximately 10ms.

So why has this been done? Earlier on, we stated that the relay drop out (end of timing sequence) has the same effect as switching the ignition off. By delaying the relay switch off at the end of the timing sequence, we can feed a blanking pulse to IC1d to prevent the circuit from retriggering.

Here's what happens. In addition to driving IC2c, the output of IC2a also feeds a differentiator consisting of a 1μF capacitor and a 270kΩ resistor. Thus, when pin 11 of IC2a switches high at the end of the timing sequence, a positive pulse is applied to pin 8 of IC2b and a corresponding negative pulse appears at pin 10.

This negative pulse effectively latches the output of IC1d high for about 250ms. This period easily encompasses the 10ms relay drop-out delay and the following 30ms trigger pulse, and thus prevents the circuit from false triggering.

Power for the circuit is derived from the car battery. The two 10Ω resistors and the associated 0.1μF ceramic capacitors provide supply decoupling, while D1 and D2 protect the circuit against dangerous ignition spikes. Diode D4 protects Q2 by quenching the back EMF when the relay turns off.

Construction

A printed circuit board coded 86au7 and measuring 106 x 46mm accommodates all the parts with the exception of switch S1 and the LM334 temperature sensor.

No particular procedure need be followed with the PCB assembly although we suggest that the relay be left till last. Note carefully the orientation of the semiconductors and the electrolytic capacitor when they are being installed and don't forget the wire link adjacent to VR1.

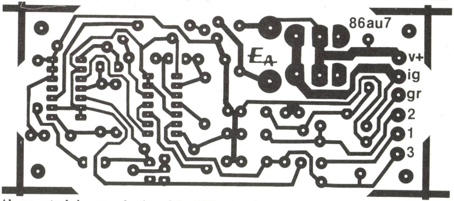
A PCB-mounting mains terminal block is used to terminate external connections to the PCB, the exception being the leads to S1. Note that although IC sockets were used in the prototype, we recommend that constructors solder the ICs straight in. Sockets only add to the cost and are a potential source of unreliability.

The circuit can be tested off the car if you prefer. Set the trigger temperature to minimum (clockwise) and solder a 100kΩ resistor in parallel with the 1.5MΩ resistor (RT). This will give a timing period of only a few seconds.

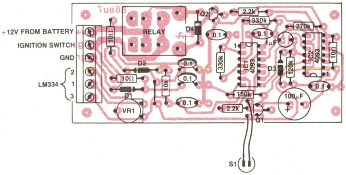
With the ground and battery connections made, briefly connect the ignition input to the battery input. When you break this contact, the relay should pull in and stay in for a few seconds. Assuming all is well, remove the 100kΩ resistor across RT.

Installation

Once construction has been completed, the circuit can be housed in a suitable case and installed underneath the dashboard — preferably adjacent to the fusebox. Finding a suitable location for S1 may be a little trickier — it will either have to be mounted on the dash-



Above: actual size reproduction of the PCB artwork.



Above: the parts layout diagram. Take care when installing polarised components.

board or installed on the steering column.

Alternatively, if you don't wish to override the circuit, S1 can be deleted altogether.

The temperature sensor is mounted on the radiator, remote from the rest of the circuit. One suggested mounting method is to secure the sensor to one finger of the radiator cap using a small saddle clamp. Alternatively, the sensor can be secured to the guard flange on top of the radiator or to one of the mounting flanges.

Whatever you do though, don't go drilling holes through the header tank on the radiator. Note that the LM334 comes in a TO92 package — the same plastic encapsulation as used for most small transistors. The wiring between the sensor and the PCB should be run using colour-coded automotive cable.

The ignition and +12V connections are best picked up from the fusebox. These connections can be made using either piggyback spade connectors or "Scotchlock" splice connectors. The chassis (GND) connection can be made to any convenient point under the dash.

Make absolutely sure that the ignition and +12V leads are correctly secured. You could be in real trouble if one of these leads comes adrift and shorts to chassis. It is a good idea to bundle the leads together using cable ties so that, even if one does come adrift, it cannot possibly create a short.

Finally, the circuit must be calibrated. To do this, bring the engine up to operating temperature and adjust VR1 fully anticlockwise. Now turn VR1 clockwise until the circuit triggers when the ignition is turned off. Further adjustments to VR1 can then be made, if necessary, as a result of on road experience.

PARTS LIST

- 1 printed circuit board, code 86au7, 106 x 46mm
- 1 project box to suit (optional)
- 1 pushbutton momentary contact switch (optional, see text)
- 1 6-way PCB-mounting terminal block
- 1 12V DPDT relay, 10A contacts

Semiconductors

- 1 LM334 adjustable current source
- 2 4093 quad Schmitt NAND gates
- 1 BC327 PNP transistor
- 1 BC337 NPN transistor
- 1 1N4148 silicon diode
- 1 1N4002 silicon diode
- 2 15V 1W zener diodes

Capacitors

- 1 100µF 16VW electrolytic
- 1 1µF 16VW bipolar electrolytic
- 2 0.1µF ceramic
- 4 0.1µF metallised polyester

Resistors (0.25W, 5%)

1 x 1.5MΩ, 2 x 330kΩ, 1 x 270kΩ, 1 x 120kΩ, 1 x 10kΩ, 2 x 2.2kΩ, 3 x 10Ω, 1 x 200Ω small horizontal trimpot

Miscellaneous

Automotive hookup wire, spade connectors, "Scotchlock" connectors, cable ties, machine screws and nuts.

Advice on Using the Turbo-Timer

This circuit must be used with discretion. Never leave the car with the engine still running, as the vehicle will not be properly secured.

Finally, never idle your car for an extended period of time inside your garage. Carbon monoxide fumes from the exhaust are dangerous.

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PAYING TOO MUCH FOR YOUR EXISTING PRODUCTS?
IF YOU ANSWER "YES" CALL ZAP NOW!!
ZAP ELECTRONICS NOW SUPPLY OVER 300 RESELLERS ACROSS AUSTRALIA
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Erase your EPROMs quickly and safely. This unit is the cost effective solution to your problems. It will erase up to 9 x 24 pin devices in complete safety, in about 40 minutes (less for less chips).

Features include:

- Chip drawer has conductive foam pad
- Mains powered
- High UV intensity at chip surface ensures EPROMs are thoroughly erased
- Engineered to prevent UV exposure
- Dimensions 217 x 80 x 68mm

Without timer Cat. X14950

Special, only $79.95

SCOPE 60W SOLDERING SYSTEM

- Infinitely adjustable temp. 200 C to 470 C. Sliding control selects desired tip temperature (LED readout monitors tip temp.)
- Safety holder features ceramic burn-proof bush and can be converted to left-hand-side.
- Soft and cool hand grip in pliable rubber.
- Screw type connector prevents accidental plug removal and guarantees solid contacts.
- Temperature lock allows production supervisors to control soldering temperatures.
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- Optional 30W soldering pencil is available for finer work.

Cat. T12900 **Normally $159**

NOW $149

POWERFULL MINI DRILL

Featuring a powerful 6000 r.p.m. motor, this lightweight (113gm) drill is ideal for many jobs. Perfect for PCB work! Has a 0.8 to 1.2mm chuck and 1mm drill bit.

Requires 12V 1 AMP.(use with M19010)

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P17016 16 pin	**$14.50**
P17024 24 pin	**$14.50**
P17028 28 pin	**$19.50**
P17040 40 pin	**$22.50**

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Size: 14 inch
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Sync. Vert. Scan Freq: 50 Hz
Band width: 18 MHz
Resolution: 640 x 400 dots
Display Format: 80 x 25 Characters
Display Colours: 16 colours.
Input Connector: 9 pin D type

Cat. X14520 .... **only $695**

ARLEC SUPER TOOL

A versatile 12V electric tool for...

- Sanding
- Engraving
- Grinding
- Polishing
- Cutting
- Drilling
- Milling
- Erasing, etc.

Features:

Operates on safe, low 12 volts from mains electricity via AC adaptor (supplied). Light and easy to handle with touch switch and lock for continuous running. High torque motor. 10,000 R.P.M. Can drill 2mm holes in steel. 2 year guarantee

Contents:

- 12V Super Tool
- Plugpack AC adaptor
- 1 spherical milling cutter
- 1 wire brush
- 1 grinding wheel
- 4 drill bits, 0.6, 0.8, 1.0, 1.2mm
- Set of 5 chuck collets
- 6 eraser sticks
- Instruction sheets

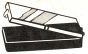
Cat. T12300 .... **$49.95**

UHF TO VHF TUNEABLE DOWN CONVERTER

Suits all TV's and allows VHF sets to watch and listen to SBS Channel 28

- Has built in amplifier to ensure no signal loss.
- Tuneable UHF band 4/5 to VHF channel 1.
- Power supply 12V DC 100mA (included).
- Allows TV without UHF to recieve on-air UHF signal or use VCR, Video Game, Computer, etc.

Cat. L15021 **$99**

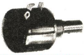


IC STORAGE CASE

Electro static charge proof plastic IC case with conductive sponge.
Dimensions: 75 x 130 x 19mm.

Cat. H10095 **NORMALLY $8.95**

SPECIAL, ONLY $7.95



10 TURN WIRE WOUND POTENTIOMETER

Spectrol Model 534
1/4" shaft.

Equiv (Bourns 3540S, Beckman 7256)
Dials to suit 16-1-11, 18-1-11, 21-1-11.

R14050	50R	R14100	5K
R14055	100R	R14110	10K
R14060	200R	R14120	20K
R14070	500R	R14130	50K
R14080	1K	R14140	100K
R14090	2K		

1-9	10+
$13.50	**$12.50**

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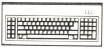
- 48 switching possibilities per day
- 240V AC, 2400 watt, 10 amp
- Suitable for turning on...
  Heaters/Coolers
  pool filter
  electric blankets
  cooking appliances
  waking you, even making the coffee!
  lights etc for security while you're away from home!
- Bargain Price!

Cat. M22002 **only $19.95**



"IBM AT STYLE" KEYBOARD

- 100% IBM* PC, XT compatible,
- low profile keyboard design,
- proper placement of shift keys with large key tops to suit professional typists
- 3 step height/angle adjustment.
- Cherry brand TS-M0001 19mm low profile switches, meet 30mm ergonomic requirement, and provide high performance and maximum reliability.
- Curl lead plugs straight into IBM* PC/XT
- Status displays, (3)

Just like the "real McCoy" only at a fraction of the price!

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(Includes cable, but not RAM)
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(41256 RAM not included)
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(2 drive capability)
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Cat. X18026 .... **$59.50**

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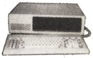

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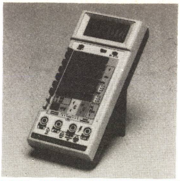
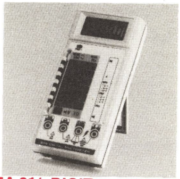


605 3½ DIGIT MULTIMETER

As reviewed in March EA!
See specification tables below for details.

Cat. Q11035 .... **$79.95**



705A 3½ DIGIT MULTI/CAPACITANCE METER

See specification table below for details.

Cat. Q11040 .... **$119**

605 & 705A SPECIFICATIONS

Capacitance

Range	Resolution	Accuracy 605	Accuracy 705A	Test Signal	Max. Input
2nF	1pF	NC	3.5% - 4	400mV rms	3V DC/peak AC on all ranges
20nF	10pF			512 Hz 40mV rms	
200nF	100pF				
2000nF	1nF				
20µF	10nF				

AC Current

Range	Resolution	Accuracy (50-500 Hz) 605	Accuracy (50-500 Hz) 705A	Burden Voltage	Overload Protection
200µA	100nA	NC	1.2% - 4	0.3V max	705A: 0.2A fuse up to 250V 605 : 2A fuse up to 250V 10A range not fused
2mA	1µA	1.2% - 4			
20mA	10µA				
200mA	100µA				
2000mA	1mA	2% - 4	NC		
10A	10mA	1.5% - 4	1.5% - 4	0.7V max	

Resistance

Range	Resolution	Accuracy (Hi) 605	Accuracy (Hi) 705A	Open Voltage	Overload Protection
200Ω	100mΩ	1% - 2	1% - 2	HiV - 3.5V LoV - 0.25V	250V DC rms on all ranges
2KΩ	1Ω	0.8% - 2	0.8% - 2		
20KΩ	10Ω				
200KΩ	100Ω				
2000KΩ	1KΩ				
20MΩ	10KΩ	2% - 4	2% - 4		

DC Voltage

Range	Resolution	Accuracy 605	Accuracy 705A	Input impedance	Overload Protection
200mV	100µV	0.5% - 1	0.5% - 1	10MΩ on all ranges	1000V DC peak AC on all ranges
2V	1mV				
20V	10mV				
200V	100mV				
1000V	1V	0.8% - 1	0.8% - 1		

AC Voltage

Range	Resolution	Accuracy (50-500 Hz) 605	Accuracy (50-500 Hz) 705A	Input Impedance	Overload Protection
200mV	100µV	1% - 4	1% - 4	10MΩ on all ranges Capacitance - 1000pF	750V rms on all ranges except 200mV AC ranges (15 seconds max above 250V rms AC)
2V	1mV				
20V	10mV				
200V	100mV				
750V	1V	2% - 4	2% - 4		

DC Current

Range	Resolution	Accuracy 605	Accuracy 705A	Burden Voltage	Overload Protection
200µA	100nA	NC	1% - 1	0.3V max	705A: 0.2A fuse up to 250V 605 2A fuse up to 250V 10A range not fused
2mA	1µA	1% - 1			
20mA	10µA				
200mA	100µA				
2000mA	1mA	1.5% - 1	NC		
10A	10mA	1% - 1	1% - 1	0.7V max	

NC = Not Connected

FREE POSTAGE FOR ALL ORDERS OVER $50! FREE POSTAGE FOR ALL

NICADS!

Size	Desc.		1-9	10+
AA	1.2	A.H.	$1.95	$1.75
C	1.2	A.H.	$7.95	$6.50
D	1.2	A.H.	$7.95	$6.50

HIGH INTENSITY LED DISPLAYS

Overall Dimensions:
12.7mm across, 19mm high.
Cat. Z10190

1-9	10+	100+
$1.75	$1.50	$1.30

HIGH INTENSITY LED BAR GRAPH

Dimensions:
Overall: 63mm across, 5mm high.
LEDs: 5 x 1mm
Cat. Z10180

1-9	10+	100+
$2.95	$2.75	$2.50

SPEECH SYNTHESISER CHIPS!

SPO256A-AL2: Speech synthesiser chip, needs programming to work. $13.95

CTS256-AL2: Contains the code recognition circuit to enable the project to plug directly on the printer port, or into an IBM PC. $27.95

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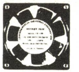
1 M/Byte	$219	$199
1.6 M/Byte	$239	$219



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Not noisy pullouts! Stacks of uses in power amps, computers, hotspot cooling etc. Anywhere you need plenty of air.

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240V	$3\frac{1}{2}$"	Cat. T12465	$12.95
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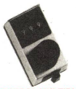
10+ fans (mixed) only $10 each!



SPECTROL MULTIDIALS

Model 16-1-11 (.9")
Cat.R14400 .... $16.95
Model 18-1-11 (1" x 1.75" Rect.)
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Cat.R14410 .... $37.50

PROTOCARD FOR IBM*

- Size 335 x 101mm (approx.)
- 5,000 holes (approx.)
- 1mm diameter
- Double sided
- Plated through
- Solder pad both sides
- Gold plated edge connector

Cat. H19110 .... $49.50

EXTENDER CARD FOR IBM*

Now available! How long have you been waiting for one of these?
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Cat. No.	Description	Price
P11000	100 Holes	$ 2.75
P11005	640 Holes	$10.75
P11007	640+100 Holes	$13.00
P11009	640+200 Holes	$17.50
P11010	1280+100 Holes	$19.95
P11011	1280+300 Holes	$32.50
P11012	1280+400 Holes	$36.75
P11015	1920+500 Holes	$57.50
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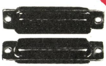
DPM-200 PANEL METER

- **Ultra Low Power**
- **Separately Addressable Annunciator**
- **15mm Digits**
- **Bandgap Reference**

A low profile LCD DPM with a range of useful symbols as shown. The DPM 200 features 15mm $3\frac{1}{2}$ digit display, and ultra low current consumption and a bandgap reference for high stability. It also features Auto-zero, Auto-polarity, 200mV fsd. It may be used in single-ended, differential or ratiometric modes. The fsd can be easily changed by the user to indicate any other units. The decimal points and symbols can all be driven from an internal source. Wide supply and symbols can all be driven from an internal source. Wide supply rail (5-15V DC) with a variable threshold low battery warning indicator. Supplied with mounting clips and comprehensive data sheet.

SPECIFICATIONS:
Accuracy: 0.1% + −1 digit
Linearity: + −1 digit
Samples/sec: 3
Temp. Stability: 50 ppm typical
Temp. Range: 0 - 50°C
Supply Voltage: 5 - 15V DC
Supply Current: 50uA typical
Max DC Input Volts: + −20V

Cat. Q15510 **$99.95**



RS232 & 'D' TYPE SPECIALS

Part	Description	Cat.No.	Price
DE9S	9 pin Female	P10881	$1.75
DE9P	9 pin Male	P10880	$2.25
DE9C	9 pin cover	P10882	$1.95
DA15P	15 pin Male	P10890	$2.10
DA15S	15 Female	P10891	$2.25
DA15C	15 pin cover	P10892	$1.15
DB25P	25 pin Male	P10900	$1.95
DB25S	25 Female	P10901	$2.95
DB25C	25 pin cover	P10902	$1.20

RED HOT SPECIALS
to bring you out of hibernation!

PUSH BUTTON DIALLERS

Tired of old fashion dialling and re-dialling engaged numbers? These convenient push button diallers include last number redial (up to 16 digits) and instructions for an easy changeover.

Cat. A12030 . **NORMALLY $19.95**
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Stylish, swivel base monitor, available in amber or green.
Green Cat. X14506 **Normally $215**
Amber Cat. X14508 **Normally $219**
SPECIAL, ONLY $199

CRYSTALS SPECIALS

We simply have too many of these prime spec. crystals in stock!

Description	Cat.No.	1-9	10+
1MHz	Y11000	$6.00	$5.20
1.8432MHz	Y11003	$6.00	$5.20
4MHz	Y11020	$2.00	$1.60
4.194304MHz	Y11022	$2.00	$1.60
4.433618MHz	Y11023	$2.00	$1.60
4.75MHz	Y11025	$2.00	$1.60
4.915200MHz	Y11026	$2.00	$1.60
5MHz	Y11030	$2.00	$1.60
6MHz	Y11040	$2.00	$1.60
6.144MHz	Y11042	$2.00	$1.60
6.670MHz	Y11045	$2.00	$1.60
8MHz	Y11050	$2.00	$1.60
8.867238MHz	Y11055	$2.00	$1.60
10MHz	Y11060	$2.00	$1.60
12MHz	Y11070	$2.00	$1.60
14.31818MHz	Y11072	$2.00	$1.60
15MHz	Y11075	$2.00	$1.60
18MHz	Y11082	$2.00	$1.60
18.432MHz	Y11085	$2.00	$1.60
20MHz	Y11090	$2.00	$1.60

APPLE* COMPATIBLE SLIMLINE DISK DRIVES

Japanese Chinon mechanism,
Cat. X19901 Normally $225
NOW $195
(*Apple is a registered trade mark.)

MITSUBISHI DISK DRIVES

Double sided, double density, 1 M/Byte unformatted, 80 track per side.
Cat. C11953 **$280**

M2896-63
Slimline 8" Disk Drive, Double sided Density No AC power required. 3ms track to track, 1.6 Mbytes unformatted, 77 track side 10s/su10 bit soft error rate.
Cat. C11916 **$895**
Case & Power Supply to suit
Cat. X11022 **$159**

M4854
Slimline $5\frac{1}{4}$" disk drive. Double sided, double density, 96 track/inch, 9621 bit/inch, 1.6Mbyte unformatted 3ms track to track access, 77 track/side.
Cat. C11904 **$375**
Case & Power Supply to suit.
Cat. X11011 **$109**

M4853
Slimline $5\frac{1}{4}$" disk drive, Double sided, double density, 1 Mbyte unformatted, 3ms track to track, 80 track/side, 5922 bits/inch.
Cat. C11903 **$295**

M4851
Slimline $5\frac{1}{4}$" disk drive. Double sided, double density 500K unformatted, 40 track/side. Steel band drive system.
Cat. C11901 **$249**
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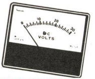
Cat. X11011 **$109**

M4855
Slimline $5\frac{1}{4}$" disk drive, double sided, double density, 96 track/inch. 2.0 Mbytes unformatted.
Cat. C11905 **$385**



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Cat.No.	Description	Price
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Q10520	MU45 0-1A	12.50
Q10525	MU45 0-20V	12.50
Q10530	MU52E 0-1A	14.50
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Q10535	MU45 VU PMetre	14.95
Q10538	MU65 0-50uA	16.95
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FUSE SPECIAL 3AG

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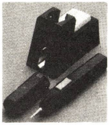
1-99	100-999	1000+
8¢ each	6¢ each	5¢ each



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- Built in solder point illumination
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- Sponge pad attach to stand
- Plug pack power adaptor
- Includes Nicad battery
- Instructtion manual
- 12 months warranty

Cat. T12480 .... Normally $69.95
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2764	$6.25	$5.95	$5.00
27128	$6.95	$6.50	$6.25
6116	$2.95	$2.75	$2.50
41256	$6.95	$6.50	$6.00
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Cat. U21614 Normally $49.50
Save $20, SPECIAL $29.50

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Tremendous Value! Dimensions 480(W) x 134(H) x 250(D)mm.
Cat. H10415 **Normally $47.95**
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Absolutely perfect for close up work! Intricate PCB's, projects, etc., will be a breeze under this superb, adjustable magnifying lamp.

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- Adjustable head for optimum viewing angle.
- Comes with desk clamp. (interchangeable with base)
- Fantastic Value!!

Cat. **Our price $89**

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- In built light indicator for night illumination.
- Designed for 12 volt negative earth electrical systems.
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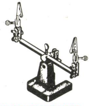
- Tachometer: 0 - 9900kph
- Speed alert: 40 - 120kph
- Complete with mounting hardware.

Cat. A15064 **Normally $69.50**
SPECIAL, ONLY $59.50



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- Four digit, changeable code.
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- Relay output.
- Panic button.
- Normally open tamper switch.
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- ACP3 compatible.

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Save money on expensive batteries with this universal battery charger. Features include meter tester, and provisions for D, C, AA, AAA, N, button and cell batteries, 9V and 6V (square types). Comes complete with detailed instructions.

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74S

74S00	.60
74S02	1.00
74S03	1.00
74S04	1.00
74S05	1.50
74S08	1.00
74S09	1.50
74S10	1.00
74S11	1.00
74S15	1.60
74S20	1.20
74S22	1.50
74S30	1.00
74S32	1.00
74S37	1.70
74S38	1.70
74S40	1.20
74S51	.80
74S64	1.20
74S65	1.20
74S74	1.30
74S86	1.60
74S109	2.50
74S112	1.30
74S113	1.30
74S133	1.20
74S134	1.40
74S135	1.30
74S138	3.30
74S139	3.30
74S140	1.90
74S151	3.10
74S153	2.00
74S157	3.10
74S158	3.10
74S160	5.90
74S161	5.90
74S162	7.90
74S163	7.90
74S168	11.50
74S169	11.50
74S174	4.50
74S175	4.50
74S181	8.50
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74S199AN	4.10
74S189	8.50
74S194	3.30
74S195	2.90
74S196/82590	4.90
74S197/82591	4.90
74S201	9.90
74S214AN	P.O.A.
74S225	10.90
74S226	7.90
74S240	6.90
74S241	6.90
74S244	9.90
74S251	3.90
74S253	4.90
74S257	3.30
74S258	3.30
74S260	2.90
74S274	POA
74S275	POA
74S280	5.90
74S281	POA
74S283	7.90
74S287	4.90
74S288	4.90
74S299	13.90
74S301	13.90
74S314	POA
74S330	POA
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74S373	9.90
74S374	9.90
74S381	9.90
74S387	3.30
74S412 8212	5.90
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74S470	9.90
74S471	9.90
74S472	9.90
74S473	9.90
74S474	9.90
74S475	9.90
74S482	11.90
74S489	7.90

74H

74H00	.60
74H01	.80
74H02	.80
74H03	.80
74H04	.80
74H05	.90
74H08	1.10
74H10	.80
74H11	.80
74H12	.80
74H15	.80
74H20	.80
74H21	.90
74H22	.80
74H30	.90
74H40	.90
74H50	.90
74H51	.90
74H52	.90
74H53	.90
74H54	.90
74H55	.90
74H60	.90
74H61	.90
74H62	.90
74H64	.90
74H65	.90
74H71	1.40
74H72	1.20
74H73	1.80
74H74	1.80
74H76	1.90
74H78	1.90
74H87	7.90
74H101	1.80
74H102	1.80
74H103	2.50
74H106	2.50
74H108	2.50
74H113	1.10
74H114	1.10
74H183	7.90

74C

74C00	.50
74C02	.60
74C04	.80
74C08	.80
74C10	.80
74C14	1.40
74C20	.80
74C30	.80
74C32	.80
74C42	1.90
74C48	2.50
74C73	1.40
74C74	1.70
74C76	1.90
74C83	2.30
74C85	2.30
74C86	1.50
74C89	8.90
74C90	1.90
74C93	1.90
74C95	2.00
74C107	1.20
74C150	6.50
74C151	4.20
74C154	6.00
74C157	3.75
74C160	1.90
74C161	1.90
74C162	2.00
74C163	2.00
74C164	2.50
74C165	2.50
74C173	1.90
74C174	1.90
74C175	1.90
74C192	2.00
74C192	2.00
74C193	2.00
74C195	2.00
74C200	14.00
74C221	2.75
74C240	3.75
74C244	3.95
74C373	4.75
74C374	4.45
74C901	3.00
74C902	2.50
74C903	2.50
74C904	2.50
74C905	15.00
74C906	2.90
74C907	2.90
74C908	2.75
74C910	14.00
74C911	12.50
74C912	12.50
74C914	4.50
74C915	4.00
74C917	15.50
74C918	2.90
74C920	12.50
74C921	12.50
74C922	7.50
74C923	7.90
74C925	9.90
74C926	9.90
74C927	9.90
74C928	9.00
74C929	9.50
74C930	2.75
74C932	2.50
74C941	2.50
74C989	8.90

74LS

74LS00	.35
74LS01	.40
74LS02	.40
74LS03	.40
74LS04	.60
74LS05	.60
74LS08	.40
74LS09	.80
74LS10	.60
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74LS14	.80
74LS15	.80
74LS19	.90
74LS20	.50
74LS21	.90
74LS22	.90
74LS24	.90
74LS26	.90
74LS27	.90
74LS28	.90
74LS30	.40
74LS32	.70
74LS33	.70
74LS37	.70
74LS38	.80
74LS40	.80
74LS42	.60
74LS47	1.00
74LS48	1.00
74LS49	1.80
74LS51	.70
74LS54	.80
74LS55	.80
74LS63	2.80
74LS73	.60
74LS74	.60
74LS75	.60
74LS76	1.00
74LS77	1.00
74LS78	1.10
74LS83	.70
74LS85	.60
74LS86	.80
74LS90	.60
74LS91	.60
74LS92	.60
74LS93	.70
74LS95	1.20
74LS96	1.20
74LS107	.90
74LS109	.60
74LS112	.70
74LS113	.70
74LS114	.80
74LS122	1.30
74LS123	.90
74LS125	.80
74LS126	1.20
74LS132	1.50
74LS133	4.90
74LS136	1.50
74LS138	.80
74LS139	.80
74LS145	2.10
74LS147	2.50
74LS148	1.90
74LS151	1.20
74LS152	1.95
74LS153	1.00
74LS154	2.95
74LS155	1.00
74LS156	1.50
74LS157	1.10
74LS158	1.00
74LS160	1.00
74LS161	.80
74LS162	1.50
74LS163	1.10
74LS164	.90
74LS165	1.00
74LS166	2.55
74LS169	2.45
74LS173	.90
74LS174	.90
74LS175	.80
74LS181	4.00
74LS190	1.50
74LS191	1.20
74LS192	1.20
74LS193	1.20
74LS194	1.20
74LS195	.90
74LS196	.90
74LS197	1.75
74LS221	2.00
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74LS241	1.90
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74LS243	1.90
74LS244	1.50
74LS245	2.60
74LS247	1.30
74LS248	1.50
74LS249	1.60
74LS251	1.50
74LS253	1.20
74LS257	.70
74LS258	1.20
74LS259	1.50
74LS261	2.50
74LS266	1.20
74LS273	1.95
74LS275	6.80
74LS279	.60
74LS280	2.60
74LS283	1.50
74LS290	1.50
74LS293	1.30
74LS295	1.75
74LS297	6.50
74LS298	1.20
74LS299	3.90
74LS320	3.95
74LS321	3.95
74LS322	6.75
74LS323	6.50
74LS324	2.20
74LS326	2.20
74LS327	2.20
74LS352	2.20
74LS353	2.20
74LS354	3.95
74LS365	1.00
74LS366	1.00
74LS367	.60
74LS368	1.00
74LS373	1.90
74LS374	1.90
74LS375	1.00
74LS377	2.15
74LS378	1.20
74LS379	1.90
74LS386	1.00
74LS390	1.80
74LS393	1.80
74LS395	2.00
74LS396	2.50
74LS398	3.00
74LS399	1.90
74LS424	5.50
74LS440	5.50
74LS441	5.50
74LS442	5.50
74LS443	5.50
74LS445	2.20
74LS446	5.50
74LS447	1.90
74LS448	5.50
74LS449	5.50
74LS490	3.20
74LS540	5.95
74LS541	3.95
74LS621	2.75
74LS622	2.75
74LS623	5.95
74LS629	5.95
74LS640	3.95
74LS642	2.75
74LS643	2.75
74LS644	2.75
74LS645	2.75
74LS668	1.75
74LS669	1.75
74LS670	2.75
74LS673	12.55
74LS674	12.55
74LS690	3.95
74LS691	3.95
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TL073	3.20
TL074	4.90
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TL082	2.50
TL083	2.90
TL084	3.45
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LM310H	3.20
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LM358	1.40
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LM383	3.90
LM384	3.50
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LM387	2.00
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LM391	2.90
LM393	1.00
LM394CH	$.95
LM395T	9.95
LM396K	22.50
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NE544	6.50
NE555	.40
NE556	1.20
NE558	5.00
NE560	4.60
NE567	2.00
NE570	5.90
NE571	5.90
NE592	6.90
NE594	9.50
LM709-14	1.50
UA710CN	1.00
LM711	1.20
LM723	.75
LM723CH	1.50
LM725	4.75
LM733	1.50
LM739	2.75
LM741	.60
UA747	1.30
UA748	1.00
MC1310	9.50
MC1312	7.95
MC1314	7.95
MC1315	8.95
MC1327	7.95
MC1350	1.95
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MC1445	5.95
MC1456	1.95
MC1458	1.20
MC1466L	21.50
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CA3130T	2.95
CA3140E	2.20
CA3140T	2.95
CA3240E	11.95
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CA3900	1.20
CA3905	1.75
CA3909	2.95
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LM3914	5.90
LM3915	5.90
LM3916	5.90
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RC4194	3.90
MM5369	4.95

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C103B	.90
C106B	.90
C122D	2.50
C122E	2.95
C260D	8.50
C260E	9.90
2N2646	1.20
2N2647	2.50
2N6027	.90

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AC126	1.20
AC127	1.20
AC128	1.20
AC187	1.50
AC188	1.50
AC149	3.40
AD161	2.90
AD162	2.90
AF118	2.90
BC107	.50
BC108	.50
BC177	.60
BC178	.60
BC179	.60
BC182L	.40
BC212	.30
BC318	.30
BC320	.40
BC327	.30
BC328	.30
BC337	.40
BC338	.40
BC546	.40
BC547	.20
BC548	.20
BC549	.20
BC550	.40
BC556	.40
BC557	.20
BC558	.20
BC559	.20
BC639	.50
BC640	.50
BCY70	1.90
BCY71	1.90
BD139	.60
BD140	.60
BD201	.90
BD232	.90
BD233	.90
BD235	.90
BD236	.90
BD237	.90
BD238	.90
BD262	1.20
BD263	1.20
BD437	1.50
BD488	1.50
BD647	1.80
BD648	1.80
BD677	1.80
BD681	2.00
BD682	2.00
BDV64B	3.90
BDV65B	3.90
BDX63	6.50
Y96 (BUX 80)	4.90
BDY97 (BUX 80)	4.90
BF115	1.50
BF167	1.20
BF173	1.20
BF177	1.20
BF180	1.20
BF182	.90
BF183	.60
BF184	.60
BF198	.60
BF199	.60
BF200	1.20
BF245	1.50
BF337	1.50
BF338	1.90
BF458	1.00
BF459	1.00
BF469	1.20
BF470	1.20
BF494	.90
BF495	.90
BFW10	1.50
BFW11	1.50
BFW16	1.50
BFY50	1.20
BFY90	1.90
BFX90	1.50
BU126	2.50
BU208	4.90
BU326	3.90
BUX80	4.90
MFE131	2.90
MFE3001	9.90
MFE3003	6.95
MJ413	5.90
MJ802	7.50
MJ901	4.50
MJ1001	3.90
MJ11011	9.90
MJ11015	14.50
MJ11016	14.50
MJ15003	6.50
MJ15004	6.50
MJ15024	10.00
MJ2501	8.90
MJ2955	2.50
MJ3001	8.00
MJ4032	12.50
MJ4502	6.90
MJE340	1.50
MJE350	1.90
MJE371	2.90
MJE521	2.50
MJE700	3.50
MJE800	2.90
MJE2801	3.95
MJE2955	4.90
MJE3055	3.90
MJE13005	5.90
MJE13007	7.90
MJE13009	12.50
MPF121	2.50
MPF131	2.50
MPSA05	1.00
MPSA06	1.00
MPSA10	1.00
MPSA12	1.00
MPSA13	1.00
MPSA14	1.00
MPSA20	1.00
MPSA42	1.00
MPSA43	1.20
MPSA55	1.00
MPSA56	1.00
MPSA63	1.00
MPSA65	1.00
MPSA92	1.00
MPSA93	1.20
MPF102	.90
MPF103	.90
MPF105	.90
MPF106	.90
MPF109	.90
MPSL01	1.50
MPSL51	1.50
MPSU02	1.75
MPSU52	1.90
MPSU56	1.75
MP131	1.75
MRF221	19.50
MRF237	5.90
MRF238	29.50
MRF245	53.50
MRF455	37.00
MRF475	12.50
MRF603	19.50
MRF641	49.00
MRF646	53.00
MRF901	2.90
MPF131	1.90
TIP31A	.70
TIP31B	.70
TIP31C	.75
TIP32A	.70
TIP32B	.70
TIP32C	.75
TIP41C	1.50
TIP42A	1.40
TIP42C	1.50
TIP49	1.90
TIP50	2.20
TIP53	2.50
TIP111	1.50
TIP112	1.50
TIP116	1.50
TIP117	1.50
TIP120	1.50
TIP122	1.50
TIP125	1.50
TIP127	1.50
TIP145	3.40
TIP2955	1.50
TIP3055	1.50
2N301	4.00
2N429	$7.95
2N697	1.00
2N918	1.00
2N1304	1.00
2N1613	1.20
2N2102	1.90
2N2219	.90
2N2222A	1.00
2N2369	1.00
2N2484	1.00
2N2646	1.95
2N2647	3.95
2N2894	1.00
2N2904	1.10
2N2905	1.10
2N2906	1.10
2N2907	1.10
2N3019	1.90
2N3053	.90
2N3054	1.90
2N3055	1.00
2N3096	1.20
2N3109	1.90
2N3251	1.90
2N3302	1.90
2N3440	1.80
2N3441	2.90
2N3442	3.50
2N3563	.30
2N3564	.30
2N3565	.30
2N3566	.30
2N3567	.30
2N3568	.30
2N3569	.30
2N3638	.30
2N3640	.30
2N3641	.30
2N3642	.30
2N3643	.30
2N3644	.30
2N3645	.30
2N3646	.30
2N3702	1.20
2N3704	1.40
2N3739	4.50
2N3771	5.50
2N3772	5.70
2N3773	5.90
2N3792	6.00
2N3819	1.20
2N3866	2.95
2N3904	1.00
2N3906	1.00
2N4030	1.50
2N4032	2.20
2N4033	2.20
2N4036	2.50
2N4121	1.50
2N4123	1.50
2N4236	1.90
2N4237	1.90
2N4248	.40
2N4249	.40
2N4250	.40
2N4258	.50
2N4355	.50
2N4356	.50
2N4360	1.00
2N4401	.30
2N4402	.30
2N4403	.30
2N4416	1.90
2N4427	3.90
2N4919	2.90
2N5088	1.00
2N5089	1.00
2N5139	1.20
2N5179	1.20
2N5190	2.50
2N5191	3.30
2N5192	3.10
2N5193	2.50
2N5194	2.95
2N5195	3.30
2N5210	1.50
2N5245	1.50
2N5303	8.50
2N5401	1.50
2N5457	1.00
2N5458	.90
2N5459	.90
2N5461	.90
2N5462	.90
2N5485	.90
2N5486	.90
2N5489	14.50
2N5590	26.50
2N5591	29.50
2N5641	19.50
2N5656	2.50
2N5770	.30
2N5777	1.50
2N5830	.30
2N5831	.30
2N5873	1.40
2N5874	1.70
2N5944	15.50
2N5945	18.50
2N5946	19.50
2N5961	1.90
2N6027	1.00
2N6049	1.90
2N6080	21.50
2N6083	26.90
2N6084	37.90
2N6122	1.90
2N6125	1.90
2N6130	1.90
2N6133	1.90
2N6256	14.50
2N6259	13.50
2N6274	29.50
2N6378	4.90
2N6425	4.50
2N6578	4.90
3N201	1.50
2SA683	1.50
2SC2028	3.95
2SC2029	3.95
2SC2166	4.95
2SC1730	1.95
2SC1969	6.30
2SC1973	3.95
VN88AF	3.95
2SC372	1.95
2SC495	2.95
2SC710D	1.95
2SC73	1.95
2SC900F	1.95
2SC945A	1.95
2SC1014	2.50
2SC1017	4.95
2SC1018	4.95
2SC1061	2.95
2SC1096	2.95
2SC1173	2.95
2SC1226	2.96
2SC1306	6.30
2SC1419	2.95
2SC1449	1.95
2SC1674	1.95
2SC1307	6.90
2SD288	3.95
2SD325	2.95
2SD350A	4.90
2SD525	3.95
2SK45	3.95
2SJ49	7.95
2SJ56	12.50
2SK134	7.95
2SK176	12.50
1N4002	.15
1N4007	.20
1N5404	.30
1N5408	.40
0A47	.80
0A90	.50
0A95	.50
5082-2800	2.95
5082-2811	4.95
HLMP6620	5.95

BRIDGES

1.5 AMP	
W005	.50
W02	.40
W04	.50
6AMP	
BPC602	2.90
KBPC604	3.50
KBPC608	4.50
10AMP	
KBPC1002	4.20
KBPC1004	4.90
35AMP	
KBPC3502	5.90
KBPC35014 MD	
A3504	6.90
KBPC3510 MDA	
3510	9.90

74

7400	.35
7401	.45
7402	.45
7403	.45
7404	.60
7405	.80
7406	.80
7407	.80
7408	.60
7409	.60
7410	.60
7411	.70
7412	.70
7413	.70
7414	.80
7416	.80
7417	.80
7420	.60
7425	.90
7427	.80
7430	.70
7432	.70
7437	.80
7438	.90
7440	.90
7442	.90
7445	1.00
7446	1.20
7447	1.50
7449	1.20
7450	.90
7451	.90
7473	.90
7474	.70
7475	.70
7476	.80
7485	1.20
7486	1.20
7489	3.90
7490	1.00
7493	1.00
7495	1.00
7497	2.30
74100	1.65
74107	1.20
74109	.90
74110	1.50
74121	.90
74122	.90
74123	1.50
74125	1.00
74128	1.80
74132	1.00
74139	1.50
74145	1.45
74150	1.50
74151	1.20
74154	1.75
74155	1.20
74161	1.20
74163	1.40
74164	1.20
74165	1.20
74166	1.70
74174	1.45
74175	1.20
74180	1.20
74190	1.00
74191	1.45
74192	1.65
74193	.80
74194	1.10
74195	1.00
74197	1.10
74221	1.90
74367	1.50
74368	1.50
75107	2.50
75110	2.50
75150	2.50
75154	2.50
75450	1.50
75451	.90
75452	.90
75453	.90
75461	1.50
75462	1.50
75471	3.00
75472	3.00
75491	2.00
75492	2.00
75493	3.00
8121	5.00
8123	4.00
8130	6.95
8131	5.95
8136	6.95
8303	5.50
8304	6.95
82S23	5.95
82S123	6.95
8311	5.95
8641	5.95
8820	6.95
8830	6.95
8832	6.95
8833	6.95
8834	6.95
8835	5.95
1488	1.00
1489	1.00
81LS95	3.75
81LS96	3.75
81LS97	3.75
81LS98	3.75
8T26	3.00
8T28	3.00
8T30	3.00
8T96	1.80
8T97	1.80
8T13	2.95
8T14	2.95
8080	8.00
8085	9.50
8086	19.50
8088	29.00
8155	6.50
8156	11.50
8185	37.50
8202	52.50
8203	69.50
8212	2.90
8214	4.90
8224	3.50
8226	4.90
8228	5.50
8237	19.50
8238	9.50
8243	8.50
8251	6.90
8253	7.50
8255	5.50
8257	16.50
8259	6.50
8271	89.00
8272	33.00
8273	65.00
8274	42.50
8275	38.50
8276	28.50
8279	8.50
8282	6.90
8283	6.50
8284	8.50
8286	6.50
8287	6.50
8289	73.00
8741	57.50
8748	65.00
8749	58.50
8755	33.50
8035	6.90
8039	7.90
FD1771	19.00
FD1791 (8876)	39.00
FD1793 (8877)	39.00
FD1795	39.00
FD1797	39.00
WD1691	29.50
WD2143	14.50
WD1931	22.50
WD1933	34.00
WD1983	14.75
WD1993	59.00
WD2123	26.50
WD8250	16.50
TR1602 (S1883)	8.50
TR1863	8.90
COM8116	24.00
BR1941	23.00
CRT8002A	59.90

74HC

74HC00	.60
74HC02	.60
74HC04	.60
74HC08	.60
74HC11	.60
74HC14	1.40
74HC27	.60
74HC30	.60
74HC32	.60
74HC74	1.10
74HC76	1.10
74HC85	1.40
74HC86	1.10
74HC123	1.40
74HC138	1.40
74HC139	1.40
74HC157	1.40
74HC165	2.50
74HC174	1.40
74HC221	3.60
74HC240	2.50
74HC244	2.50
74HC245	3.90
74HC367	1.40
74HC373	2.90

74F SERIES

74F00	.79
74F02	.79
74F04	.92
74F08	.79
74F10	.79
74F11	.79
74F20	.79
74F32	.79
74F64	.79
74F74	.89
74F86	1.19
74F109	.99
74F138	1.79
74F139	1.79
74F151	1.79
74F153	1.79
74F157	1.79
74F158	1.79
74F175	2.78
74F181	5.98
74F182	2.73
74F189	7.44
74F190	4.86
74F191	4.86
74F194	2.41
74F241	3.72
74F243	4.34
74F244	3.72
74F251	1.93
74F253	1.93
74F257	1.93
74F258	1.93
74F350	4.34
74F352	1.93
74F353	1.93
74F373	4.84
74F374	4.84
74F399	2.78
74F521	4.22
74F533	4.84
74F534	4.84

MEMORY

2101	6.90
2102	2.50
2114	2.95
2708	12.50
2716	9.90
2732	6.95
2764	5.95
27128	8.00
4116	3.95
4164	3.95
6116	5.00
6264	8.00
58725 (6116)	4.00
2101 (5101) (8101)	7.90
5101	7.90
8101	7.90
2532	12.50

OPTO

4N25	1.50
4N26	1.50
4N27	1.50
4N28	1.50
4N29	1.50
4N30	2.00
4N32	2.50
4N33	2.50
4N35	2.50
4N37	2.50
MCT6	2.50
MCT66	6.90
MCT2	1.50
1LD74	5.90
1LQ74	6.50
FND507	2.00
TIL31A	2.95
TIL81A	2.95
TIL306	22.50
MAN72 (DL702)	3.50
MAN74 (DL704)	3.50
BPW50	2.25
HP5082-2811	4.95
HLMP 6620	3.95
LEDS	
3mm RED	.25
2mm YELL	.30
3mm GRN	.30
5mm RED	.15
5mm YELL	.30
5mm GRN	.30
5mm ONG	.30
RED RECT	.30
GRN RECT	.30
YEL RECT	.30
RED CHROME BEZEL	1.20
YELLOW CHME BEZEL	1.20
GRN CHRME BEZEL	1.20

VOLTAGE REGS

7805C	.80
7805KC	2.50
7812UC	1.20
7812KC	2.50
7815UC	1.20
7815KC	2.50
7818UC	1.20
7818KC	2.50
7824UC	1.20
7824KC	2.50
7905UC	1.90
7905KC	3.00
7912UC	1.90
7912KC	2.50
7915UC	1.90
7915KC	2.50
7918UC	1.90
7924UC	1.90
78L05	.50
78L12	.50
78L15	.75
78L18	.75
78L24	.75
79L05	1.20
79L12	1.20
79L18	1.20
79L24	1.20
LM309K (7805KC)	1.90
LM317T	2.50
LM317K	4.50
LM317HV	9.50
LM323K	7.50
LM337T	2.90
LM338K	10.50
LM350T	6.50
LM350K	8.50
LM395K	22.50
LM396K	19.50
78H05KC	9.00
78H12KC	9.00
78HGKC	9.50
78P05KC	16.50
79HGKC	16.50
78S40	3.50
MC1496L	14.50

SPECIAL FUNCTION

LM4250	2.45
NE5534N	3.95
NE5534AN	4.95
MC3340	2.90
MC3341	2.90
76477	8.95
76488	8.95
76489	9.95
8038	6.50
OM335	22.50
OM350	10.50
XR2206	7.95
XR2207	7.95
XR2208	6.90
XR2209	6.90
XR2211	7.45
XR2216	5.90
XR2240	6.95
XR2243	7.95
XR8038	7.50
95H90	8.50
11C90	16.50
LM7555	2.90
LM7556	3.50
MC10116L	1.50
LM13600	3.95
LF13741	.80
LF13741H	1.50
DM2502	22.50
DAC0800	4.50
DAC0808	4.50
SAK140	9.50
ZN414	1.95

2N

4000	.50
4001	.50
4002	.50
4006	1.90
4007	.40
4008	1.20
4010	.90
4011	.40
4012	.40
4013	.60
4014	1.90
4015	1.90
4016	.75
4017	1.50
4018	1.90
4019	.90
4020	1.50
4021	.150
4022	1.50
4023	.75
4024	1.20
4025	.80
4026	2.40
4027	1.20
4028	1.20
4029	1.50
4030	1.50
4031	2.95
4032	2.75
4033	2.75
4034	3.50
4035	1.95
4038	3.25
4040	1.20
4041	1.50
4042	1.00
4043	1.60
4044	1.20
4045	4.90
4046	2.50
4047	1.20
4048	1.20
4049	1.00
4050	1.00
4051	1.50
4052	1.50
4053	1.50
4054	3.90
4055	3.90
4056	4.20
4060	2.50
4063	2.00
4066	2.50
4067	9.90
4068	1.00
4069	1.00
4070	.90
4071	.40
4072	.90
4073	.90
4075	.90
4076	1.50
4077	.80
4078	.80
4081	.40
4082	.80
4085	2.20
4086	2.30
4093	.75
4094	3.35
4095	2.40
4096	2.40
4097	6.50
4098	2.90
4099	3.90
4175	1.60
4194	1.95
4433	2.75
MC14433	13.90
4510	1.50
4511	1.00
4512	1.10
4513	2.65
4514	2.90
4515	2.90
4516	1.45
4517	8.75
4518	2.50
4519	1.90
4520	1.20
4521	3.90
4522	1.90
4526	1.85
4527	2.65
4528	1.15
4529	1.80
4530	1.60
4531	1.65
4532	2.65
4534	8.90
4536	6.50
4539	1.65
4541	1.60
4543	2.50
4544	10.50
4549	7.25
4551	1.80
4553	5.50
4554	2.35
4555	1.10
4556	1.25
4557	7.85
4558	2.25
4559	7.25
4560	3.75
4561	1.80
4562	8.45
4566	3.00
4568	4.25
4569	2.50
4572	.75
4581	3.10
4582	2.25
4583	1.65
4584	.85
4585	2.10

ANALOG/ DIGITAL

ADC0800LCN	22.50
ADC0801LCN	23.95
ADC0803LCN	7.50
ADC0804LCN	6.50
ADC0808LCN	14.95
ADC0820	$24.95
DAC1220LCN	14.95
DAC1020LCN	13.95
DAC0832LCN	5.50

NEW ICS

74LS169	2.50
MCS2400	4.90
AY31050	12.50
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WD2793	59.00
WD2795	59.00
WD2797	59.00
LM11CN	2.95
LM1871	5.95
LM1872	5.95
Z80ADART	13.50

CRYSTALS

1MHz	9.50
1.832MHz	6.50
2MHz	5.90
2.3040MHz	6.50
2.4576MHz	5.50
2.7648MHz	4.90
3MHz	4.90
3.5795MHz	2.50
3.93216MHz	4.90
4MHz	2.90
4.194304MHz	2.90
4.433618MHz	2.90
4.44MHz	2.90
4.75MHz	2.90
4.915200MHz	6.90
4.9562MHz	2.90
5.00MHz	2.90
5.0688MHz	2.90
6MHz	2.90
6.14MHz	2.90
6.6670MHz	2.90
8MHz	2.90
8.867238MHz	4.90
10MHz	4.90
10.6445MHz	4.90
11MHz	2.90
12MHz	2.90
14.31818MHz	4.90
15MHz	4.90
16MHz	4.90
18MHz	4.90
18.432MHz	4.90
20MHz	4.90
24MHz	4.90
27MHz	4.90
32MHz	4.90
36MHz	4.90
32.768MHz	4.90

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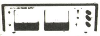
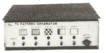


50V 5A LABORATORY POWER SUPPLY
New switchmode supply can deliver anywhere from three to 50V DC and currents of 5A at 35V or lower. Highly efficient design.
(Ea May,June'83) 83PS5
Cat. K83050 .... Normally $169
SPECIAL, $159

OP AMP TESTER
The Op Amp Tester which could save you hours in agonising whether that old op amp thats been sitting in the draw for the last year.
(ETI April '85, ETI 183)
Cat. K41830 .... Normally $26.50
SPECIAL, $21.50

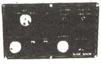
PH METER KIT
Build this pH meter for use with swimming pools to fish tanks to gardening, this pH meter has many applications around the home. This unit features a large 3 1/2 digit liquid crystal display and resolution to .01 pH units, making it suitable for use in the laboratory as well.
(EA Dec.'82) 82PH12
Cat. K82123 .... **$135**

SAVE $5



CRYSTAL CONTROLLED TV PATTERN GENERATOR
Anyone wishing to obtain the maximum performance from a colour TV reciever needs a pattern generator. Why not build this superb unit which provides five separate patterns; dot, crosshatch, checker board, grey scale and white raster?
Note: The RIE kit includes a large ABS type case!
(80pg6, EA June '80)
Cat. K80033 .... Normally $67.50
SPECIAL, $62.50

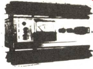
30 V/1 A FULLY PROTECTED POWER SUPPLY
The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0V to 30V and selectable current limit. Both volatage and current metering is provided. (ETI Dec.'83) ETI 162
Cat. K41620 .... Normally $59.50
SPECIAL, $44.50



SLIDE CROSS-FADER
Want to put on really professional slide show? This slide cross-fader can provide smooth dissolves from one projector to another, initiate slide changing automatically from an in-built varialbe timer, and synchronise slide changes to pre-recorded commentary or music on a tape recorder. All this at a cost far less than comparable commercial units. (EA Nov.'81) 81SS11
Cat. K81110 .... Normally $99.00
SPECIAL, $89.00

MULTI SECTOR ALARM STATION
Protect your home and possessions from burglars with this up to the minute burglar alarm system. It's easy to build, costs less than equivalent commercial units, and features eight seperate inputs, individual sector control, battery back up and self-test facility.
Specifications:
- Eight sectors with LED status indication.
- Two delayed entry sectors.
- Variable exit, entry and alarm time settings: entry delay variable between 10 and 75 seconds; exit delay variable between 5 and 45 seconds; alarm time variable between 1 and 15 minutes.
- Resistive loop sensing: suits both normally open and normally closed alarm sensors.
- Battery back-up with in-built charger circuit.
- Built-in siren driver.

The RIE kit includes a superb printed and prepunched metal case and inside metal work, plus a gell battery! Unbeatable VALUE!
Cat. K85900 .... Normally $129
SPECIAL, $119



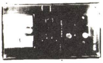
ELECTRIC DUMMY LOAD
With this unit you can test power supplies at currents up to 15 Amps and voltage up to 60 Volts. It can "sink" up to 200 Watts on a static test and you can modulate the load to perform dynamic tests.
(ETI Oct.'80) ETI 147
Cat. K41470 .... Normally $129
SPECIAL, $119

rie

MAIL ORDER HOTLINE
(03) 543 7877
(2 lines)

DELUXE CAR BURGLAR ALARM
Stop your car from being one of the 70,000+ stolen cars stolen each year with this "state of the art" car burglar alarm. Features include key switch operation, delayed entry and exit, automatic reset, and provision for an auxiliary battery. Further more, of the 10 most important features listed by NRMA, this EA Deluxe Car Alrm has 9 of them!
(84ba5, EA May '84)
Cat. K84050 .... **$79.50**

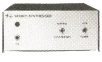
RED HOT SPECIALS to bring you out of hibernation!



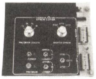
LOW OHMS METER
How many times have you cursed your Multimeter when you had to measure a low-value resistance? Well with the "Low Ohms Meter" you can solve those old problems and in fact measure resistance from 100 Ohms down to 0.005 Ohms.
(ETI Nov.'81) ETI 158
Cat. K41580 .... Normally $39.50
SPECIAL, $34.50

SERIES 3000 COMPACT STEREO AMPLIFIER
A quality compact amp that doesn't sacrifice performance! This amp delivers 20W per channel, has low distortion and costs less than $100!

SPECIFICATIONS:
Power Output:
25W RMS, one channel driven
20W RMS, both channels driven
Distortion:
1kHz: 0.03% at full power
0.013% at 12W RMS
10kHz: 0.08% at full power
Frequency response:
Phono: within 1 dB, RIAA
Other inputs: within + − 0.5dB from 10 Hz to 20kHz; −3 dB at 40kHz
Hum:
Phono: −60 dB w.r.t. 10 mV input
Other inputs: −70 dB w.r.t. 200 mV input
Noise:
Phono: −80 dB w.r.t. 10 mV input
Other inputs: −86 dB w.r.t. 200 mV input
Tone Controls:
Bass: + − 10 dB at 50 Hz
Treble: + − 10 dB at 12kHz
Slew Rate:
15V/us
Seperation:
Phono: 46 dB
Other inputs: 40 dB
Sensitivity:
Phono: 2.5 mV for full output
Other inputs: 200 mV for full output
(ETI 476, Nov. '80)
Cat. K44760 .... **$95.00**



STEREO SYNTHESISER FOR TUNERS & VCRs
Enjoy the benefits of stereo sound from your VCR, TV or AM tuner with this Stereo Synthesiser. The circuit uses just four IC's and is easy to build.
(82ms8, EA September '82)
Cat. K82091 .... **$55.00**



EPROM COPIER
This versatile EPROM copier is easy to build and will cost less than $100. It can program 2716 and 2732 EPROMs and copy 2708, 2716 and 2732 devices.
(84ec11, EA November '84)
Cat. K84110 .... **$99**

TRANSISTOR ASSISTED IGNITION SYSTEM (LATEST VERSION)
Now with longer spark duration.
(79ti11, EA February '83)
Cat. K83023 .... **$34.50**

HOWL-ROUND STABILIZER/ FREQUENCY SHIFTER
Feed back prolems in halls can be corrected with this clever gadget, especially when the selection of microphones/speaker positions doesn't help.
(ETI 486)
Cat. K44860 .... **$59.00**

FREQUENCY STANDARD
Get the equivelent of a rubidium frequency standard by draping a piece of wire over the back of your TV set!! Believe it or not your humble television can provide an extremely stable and accurate reference frequency. The wire acts as a transducer to pick up electromagnetic radiaton from the back of the set. Normally you would need to spend thousands of dollars to achieve accuracy beyond the "parts per thousand" you expect from ordinary meters. With this simple project, an extremely accurate 1MHz signal can be derived for very little outlay.
(ETI 174, July '86)
Cat. K41740 .... **$24.95**

DIGITAL CAPACITANCE METER Mk.2
Updated from the EA March '80 issue, this Digital Capacitance Meter checks capacitor values from 1pF to 99.99uF over three ranges. Its main features include a nulling circuit and a bright 4 digit LED display.
***Note:** The RIE kit contains quality silk screen printed and prepunched front panel AND an exclusive High Intensity Display!
(80cm3a, EA August '85)
Cat. K80030 .... **$59.50**

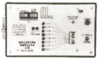
SPEAKER PROTECTION UNIT
An expensive speaker system can be readily destroyed by a 20 watt amplifier. Carelessness with a high power amplifier can melt voice coils like cheese on toast. However, with this Speaker Protection Unit you can avoid risking the misery and expense. (ETI455,)
Cat. K44550 .... **$44.95**

300 BAUD DIRECT CONNECT MODEM KIT
Think of the advantages of having your own modem!!
- Can't afford a floppy disc? Use your telephone to access one for the cost of a call.
- Bored with your old programs? Download hundreds of free programs.
- Want to get in touch with fellow computer enthusiasts? Use 'electronic mail'.
- Ever used a CP/M system? CP-DOS? UNIX? Well a modem will make a your computer a remote terminal on some of the most exciting systems around.

Save on ready built modems.
(ETI 699, May '85)
Cat. K46990 **Normally $129**
SPECIAL, ONLY $109
(Short form without phone)

ELECTRIC FENCE TESTER
This project was developed to take some guess work out of testing or checking an electric fence. Many factors can influence the operation of an electric fence energiser and fence, reducing its effectiveness. This tester indicates the presence of each pulse from the energiser and shows when the pulse voltage exceeds an amplitude of 2kV, 3kV and 5kV, once calibrated. If used in an uncalibrated mode, the unit will indicate pulse amplitudes on the fence of 40%, 60% and 100% of energiser output.
(ETI 1512, Feb. '83)
Cat. K55120 .... **$19.95**

CRYSTAL MARKER GENERATOR FOR RECIEVER AND CRO CALIBRATION
A simple but very useful piece of test equipment for calibrating and aligning recievers, transceivers and oscilloscopes. It is portable, battery operated and inexpensive to build.
(ETI 157, October '81)
Cat. K41570 .... **$37.50**



BIT PATTERN GENERATOR KIT
In applications where you are required to look for a particular byte of information in a serial or parallel data path, short of a logic analyser or a storage oscilloscope, there is not a lot to help you. However, this Bit Pattern Generator gives you a simple and ecconomical way to detect and display specific bytes of data. It may be used on both parallel and serial data paths.
(ETI 172, May '86)
Cat. K41720 (Serial/Parallel Kit)
Please phone for price

50/500MHz 7 DIGIT FREQUENCY METER
Want a high performance digital frequency meter that's easy to to build? This unit uses just five IC's, measures period and frequencies up to 500MHz, and features a bright seven digit display. Save a small fortune over comparable commercail units.
Note: The RIE Frequency Meter Kit includes high quality prepunched and silk screened front panel!
(EA December '81)
(50MHz 81fm10a, 500MHz 81fm10b)
50MHz Cat. K81120 .... **$149**
500MHz option Cat. K81121
.... **add $29.95**

BRIDGING ADAPTOR CONVERTS SERIES 5000 POWER AMPLIFIER INTO 300W MONO AMPLIFIER
Here's how to operate the two ETI477 MOSFET power amplifier in the series 5000 amp in bridge configuration with the addition of a simple, inexpensive module that fits inside the 5000 power amp.

SPECIFICATIONS:
Power Output:
300W RMS into 8 ohms
(at onset of clipping)
Frequency Response:
8 Hz to 20 kHz, +0 − 0.5dB
(determined by passive filters)
Input Sensitivity:
1V RMS for 100W output
Hum and Noise:
100dB below full output or better
Total Harmonic Distortion:
less than 0.003%
Stability:
Unconditionally stable
(ETI 479, March '82)
Cat. K44790 .... **$19.50**

SAVE $10

12/240V 40W INVERTER
This 12 240 V inverter can be used to power up mains appliances rated up to 40 W, or to vary the speed of a turntable. As a bonus, it will also work backwards as a trickle charger to top up the battery when the power is on. (EA May'82) 82IV5
Cat. K82050 .... Normally $69.95
SPECIAL, $59.95

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Proton's potent stereo receiver

The Proton D940 stereo receiver is rated at 40 watts per channel into 8-ohm loads which is pretty unremarkable in these compact disc days. Its claim to fame is its very high dynamic power which is no less than 150 watts per channel into the same 8-ohm loads. Driving 2-ohm loads, it will deliver no less than 450 watts per channel.

by LEO SIMPSON

Proton is a relatively new company based in the United States and manufacturing its products in Taiwan. It has a range of four high fidelity products, being the 440 stereo tuner, the D540 stereo amplifier, the 740 cassette deck and the D940 stereo receiver, reviewed here. The D940 receiver is effectively the D540 amplifier and 440 stereo tuner combined into the one chassis.

At first sight, there is little to set the D940 apart from other stereo receivers except that it is perhaps a little smaller and more subdued in styling than similar products from the Orient. It has the obligatory digital display for the tuner functions together with a bank of pushbuttons for the 16-station memory and search functions.

And it has the usual Bass, Treble, Balance, Volume and Speaker selector controls plus switches for Loudness and Mono mode — nothing unusual in these. Where it differs is that it has pushbutton switches for Bass equalisation and SNR and rotary selector switches labelled Record and Listen. The Bass equalisation switch is to provide a degree of boost at very low bass frequencies, to augment the response of sealed enclosures.

The SNR switch is an interesting one. This is the Schotz Noise Reduction feature of this tuner. What this does is to reduce the background hiss on weak stations by applying progressive stereo blend. It has no effect on strong signals.

The Record and Listen rotary switches combine and extend the functions of the program selector and tape monitor switch found on other stereo amplifiers. In effect, you record from one source while listening to another. Full dubbing facilities are also available for two tape decks.

The tuner functions are indicated by what appears to be a green LED display with red LEDs used to indicate some of the functions such as SNR, Bass EQ and Loudness. The signal strength indicator is a LED bargraph which contrary to the case with most tuners, is actually useful, according to our tests. For example, with two segments of the bargraph alight, you know that you have enough signal to obtain quiet (hiss-free) mono reception while three or four segments give you good stereo reception.

The D940 has a fully synthesised tuner of course and its 16-station memory allows you to store eight AM stations and eight FM stations. Manual tuning is provided for by the up and down scanning buttons.

Interconnections

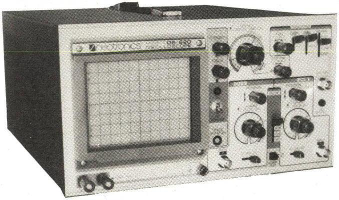
The rear panel of the Proton is quite busy with two sets of speaker connections, no less than nine pairs of RCA sockets (with the phono sockets gold-plated), and spring-loaded contacts for AM and FM antenna connections. As well, there is a clip-out loop antenna for AM reception and a 75Ω socket for FM coax input.

Next to the phono sockets are two pushbuttons: one to change from moving-magnet to moving coil cartridge operation, and the other to change from high to low impedance loading for moving coil cartridges. There is also a three-position slide switch to set the input

The Proton D940 stereo receiver — turbo-powered performance, a digital display, and comprehensive control facilities.

YOUR SCOPE

OS-620



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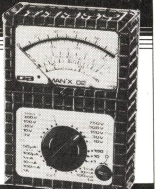

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- ★ Resistance
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Ideal for workshop and field use because of its durability and shock resistance.

Price $120.00

FREQUENCY COUNTER 1.3GHz (MODEL 6002)

- ★ 5Hz to 1.3 GHz Frequency Range
- ★ Easy touch push button controls
- ★ Measures period 1 µS to 200 mS
- ★ Three selectable resolutions in each mode
- ★ Easy to read, 8½ digit LED display

Price $698.00

Proton's D940

shunt capacitance (either 100, 200 or 320 picofarads) for moving magnet operation.

Finally, there are two pushbutton switches near the loudspeaker terminals. One of these is labelled ACC which stands for "anti-clipping circuit". This softens the normally hard clipping of a solid-state amplifier and can give an apparent increase in power.

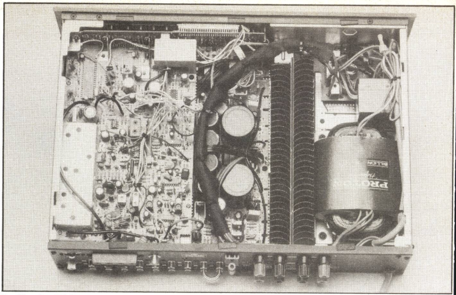
The other pushbutton has a guard bracket over it to prevent accidental changing of the setting. It provides for bridging the two power amplifiers of the D940 to give one large mono amplifier with twice single-channel rating. In this mode, the preamplifier right channel output is used to drive the bridged amplifier while the left preamplifier channel output can be used to drive an external amplifier.

Dynamic power demand

All the foregoing features are nothing really startling although they do represent an interesting control line-up. The big selling feature of the Proton D940 is its DPD circuit.

DPD stands for "dynamic power demand" and is Proton's name for a circuit which essentially boosts the short-term power capability of the power amplifiers to a figure which is four times the steady-state rating. In other words, while the amplifier is rated for a continuous power output of only 40 watts per channel into 8-ohm loads, which is fairly low these days, its dynamic power output is quoted at no less than 160 watts into the same loads. Not only that, but the Proton can deliver very high currents as evidenced by the dynamic power rating into 2-ohm loads — a phenomenal 380 watts per channel.

The simplest way of achieving such high power is to take the route that Carver and NAD have taken previously and switch in a pair of higher-voltage supply rails to the main amplifiers when the input signal rises above a threshold value. We think that's how Proton have done it and can see evidence of two pairs of supply rails. However, since we did not have access to a circuit diagram at the time of writing we cannot describe Proton's method in any detail. One point is certain: this design approach yields a receiver which is audibly much more powerful than its price, size and weight would lead you to expect.



Inside the D940 — good quality components and neatly assembled.

Dimensions, by the way, are 420mm wide, by 105mm high, by 315mm deep, including knobs, rear projections and rubber feet. Weight is 8.5kg.

A look inside the chassis reveals standard Asian electronics construction: good quality components neatly assembled. One interesting feature is the fact that it has two transformers. The main transformer is a new type of toroid which is wound from steel ribbon so that it has a circular cross-section. At first glance it looks like a C-core transformer. The circular cross-section allows it to be fitted with two large bobbins which are spun while on the core for the winding process. (These transformers are available in Australia, by the way, from at least two companies.)

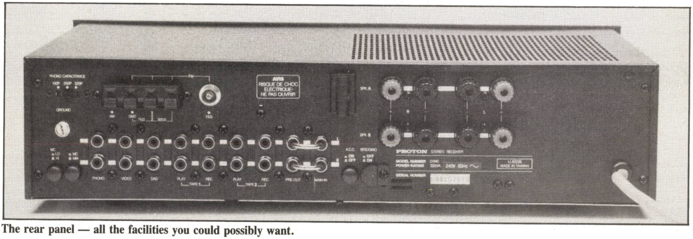
This large transformer supplies the main power demand of the amplifier. The second, much smaller, conventional transformer appears to provide the auxiliary high voltage supplies which kick in to provide the +6dB headroom of the D940.

All the power transistors for both power amplifiers are mounted on the one large finely-finned heatsink which has ventilation holes immediately above and below it, in the chassis and cover. Just as well, too, because it pumps out a lot of heat at times to the point where the chassis cover can become uncomfortably warm. For this chassis, adequate ventilation is a must.

Performance tests

Our tests concentrated on verifying that massive headroom of the D940.

Continued on page 132

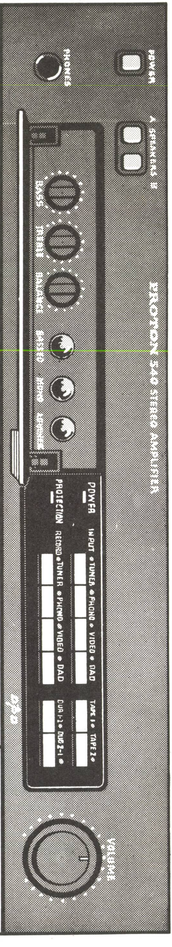


The rear panel — all the facilities you could possibly want.

PROTON

Expect to be astonished

Nowhere does music demand more of amplifiers than in the reproduction of musical peaks. Dynamic Power on Demand, a radical new design that uses two different types of circuits to supply power, lets you hear it all.


POWER
PHONES
A SPEAKERS B
BASS
TREBLE
BALANCE
PROTON 540 STEREO AMPLIFIER
POWER
PROTECTION
INPUT • TUNER • PHONO • VIDEO • DAD
RECORD • TUNER • PHONO • VIDEO • DAD
TAPE 1 • TAPE 2 •
DUB 1-2 • DUB 2-1 •
VOLUME

Dynamic-power measurements dramatically demonstrated the effectiveness of the DPD system. The standard EIA dynamic-headroom measurement, with 8-ohm loads, produced a 20-millisecond output of 156 watts (for a headroom of 5.9 dB). With 4-ohm loads, the dynamic power was 288 watts, and into 2 ohms it was a prodigious 530 watts!

By any objective criteria, the Proton D540 is an exceptional amplifier. Its low noise and distortion levels, control flexibility, cool operation, and generally ideal performance by themselves rank it among the finest amplifiers we have seen. There are many good amplifiers on the market, however, and the special quality of the D540 really shows itself in the performance of its DPD system.

Listening to CD's and other wide-range sources left no doubt of the remarkable qualities of this amplifier. It begs the issue merely to say that the D540 is by far the most powerful "40 watt" amplifier we have used (which it certainly is). More to the point, it is one of the few amplifiers of any rating we have seen whose capabilities begin to encompass the dynamic properties of live music.

What the Proton D540 *will* give you is a degree of natural dynamics usually obtainable only with a few extremely powerful and expensive amplifiers. But with such amplifiers you have to pay for a huge continuous-power capability to reproduce high peak levels for fractions of a second at a time. The D540 gives you 99 percent of the same sonic impact at a fraction of the price.

EXTRACT FROM
"STEREO REVIEW" U.S.A.

Diversified Science Laboratories' measurements confirm Proton's claims with room to spare. No doubt about it, this is the most powerful "40 watt" amplifier we've ever tested.

All told, Proton has succeeded admirably in meeting its design goals for both performance and value in the D540. The power amp is the star, but the input-selector/tape-switching scheme is admirable as well – as is the flexibility of the phono section. If you want an integrated amp that delivers far more than its price, styling, or power rating would otherwise suggest, by all means consider the D540.

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Build these 2-way hifi loudspeakers

Build this compact two-way loudspeaker system and save yourself a bundle by comparison with equivalent fully imported units. These speakers are an ideal match for our new Playmaster Sixty-Sixty amplifier without being too big or expensive. You can buy the complete kit or just the speakers and build the enclosures yourself, to save more money.

by COLIN DAWSON & LEO SIMPSON

The loudspeakers are finished in a good-looking synthetic black veneer.

While the cost of imported loudspeaker systems has gone through the roof, you can still save a considerable amount of money by building your own. And while there are presently a number of build-it-yourself loudspeakers on the market, this compact two-way system must be one of the best value-for-money buys available.

This loudspeaker system has been quite a while coming. When we were in the process of developing the Playmaster Sixty-Sixty amplifier we knew that readers would want a matching speaker system to follow. In meeting this demand, there were several approaches we could have taken which would have involved large and expensive systems, complex cabinetry and crossover networks and so on.

Instead, the system duplicates what is presently the most popular segment of the hifi market. Accordingly, it is a two-way unit with 20cm woofer and 19mm dome tweeter in a compact sealed enclosure, with a relatively simple crossover network. The design was commissioned by Scan-Audio Pty Ltd and uses loudspeakers from Vifa, one of Denmark's largest speaker manufacturers.

Just as a point of interest, Vifa drivers are used in many expensive fully imported loudspeaker brands, such as Mission, Jamo, Bang & Olufsen, Heybrook, Rogers, DCM Timewindow and Monitor Audio.

Vifa drivers

The designated woofer is the Vifa C20WG-19-08. This is a conventional woofer with a nominal diameter of 200mm. It has a foam roll surround and a doped paper cone with an effective (piston) diameter of about 155mm. The chassis is a steel pressing fitted with a ceramic magnet. In other words, it is a straightforward woofer with no frills. It

has a nominal free-air cone resonance of 39Hz and is claimed to be suitable for sealed enclosures up to 60 litres. Its Thiele-Small parameters are: Vas 82 litres; Qt 0.78.

By comparison with the no-nonsense woofer, the tweeter is an exotic little beastie. It is a 19mm soft dome unit with a ferro-fluid damped voice coil for high power handling and a very smooth frequency response. Its resonant frequency is around 1.7kHz.

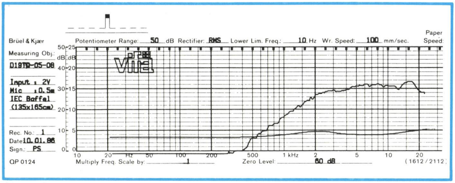
The crossover is a relatively simple network dividing the audio spectrum at 3kHz with attenuation slopes for both tweeter and woofer of 12 decibels per octave above (for the woofer) and below (for the tweeter) 3kHz.

Let's discuss the crossover network in a little more detail. It uses two air-cored inductors, two bipolar electrolytic capacitors, one metallised polyester capacitor and several wirewound resistors. Associated with the woofer is an impedance equalisation network consisting of a 6.8Ω resistor and 10μF capacitor.

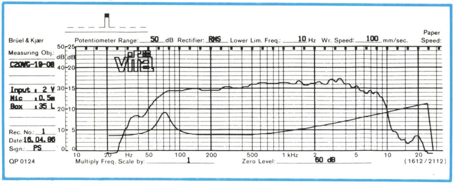
The purpose of this network is to cancel out the 0.8 millihenry inductance of the woofer voice coil which would otherwise reduce the attenuation slope of the woofer feed components, comprising the 0.42 millihenry inductor and 6.8μF capacitor. The tweeter feed components are the 3.3μF metallised polyester capacitor and 0.26 millihenry inductor.

In addition to these components, we found it necessary to attenuate the tweeter slightly, by about 2dB, by the addition of a resistive attenuator. This consists of a 2.2Ω series resistor together with an 18Ω resistor to shunt (ie, in parallel with) the tweeter. This just takes the "edge" off the tweeter response so that the overall balance is more pleasant and less likely to emphasise tape hiss and surface noise on vinyl

Two-way loudspeakers



Above: frequency response curves for the C20WG woofer and the D19TD tweeter.



This graph shows the frequency response and impedance curves of the Vifa 60-60 system.

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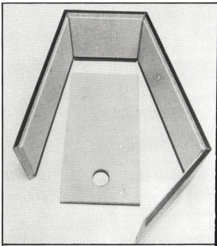


The cabinet comes as a wraparound assem bly.

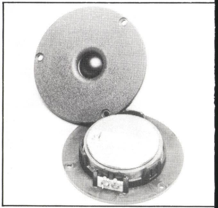
records.

The cabinet is a compact 35-litr sealed enclosure made of 16mm chip board. This size has been settled upo as ideal for a bookshelf loudspeake which can also be hung on the wall. A well as being compact, this enclosur volume also allows the woofer to handl plenty of power without running int overload.

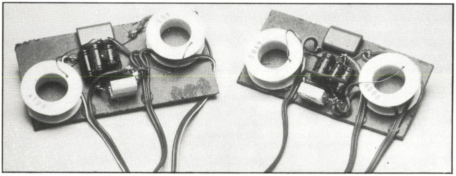
Specifically, it makes a very goo match to the recently described Play master Sixty-Sixty stereo amplifie Hence, these compact loudspeaker have been designated the Vifa Sixty Sixties.

In an average-sized lounge room an driven by the Playmaster Sixty-Sixty o an equivalently rated amplifier, thes speakers will deliver enough sound volume to satisfy the most power craze enthusiast. However, if you have larger-sized lounge room and a bigge amplifier, such as the Playmaster Serie 200, you should consider a large speaker system with more power handling capacity.

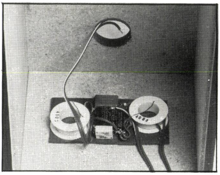
Suffice it to say that, as far as valu for money is concerned, these Vif



The D19TD tweeter is a 19mm soft dom unit with a ferro-fluid damped voice coil.



The crossover networks are relatively simple and are supplied preassembled.



The crossover is glued to the bottom of the cabinet.

Sixty-Sixty loudspeakers must be one of the best buys presently available. If your budget won't run to the $600 to $800 needed for a fully imported pair of equivalent speakers, these are the ones to go for.

Construction

Only the most basic of tools are required to assemble these loudspeakers. Even if you are a rank amateur at carpentry you will have no problems putting them together. You don't need special clamps or jigs and all timberwork has been precisely machined. You do have to be able to use a soldering iron though, to connect the loudspeakers to the crossover network.

On the other hand, if you are experienced in carpentry, you could make your own enclosures and just purchase the loudspeakers and crossover networks. By doing it this way you stand to save quite a bit of money. However, this should be balanced against the very good finish that these precut enclosures will give. They are finished in a very good-looking synthetic black veneer which is a good match for the Playmaster Sixty-Sixty, or indeed, almost any modern amplifier.

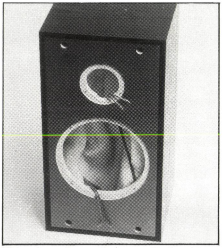
The baffleboard (on which the speakers are mounted) is also finished in a subdued grey vinyl.

The complete kit for a pair of loudspeakers is supplied in two boxes. One box is long and flat and contains all of the timberwork for the two enclosures. The other box contains the drivers, crossovers, terminal blocks, Dacron filling material, screws, etc. Although they do not look at all like a couple of hifi speakers at this stage, there is surprisingly little work involved in putting them together.

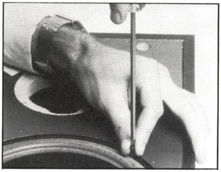
Not supplied in the kit, but nevertheless essential to construction are: (1) a tube of PVC woodworking glue; and (2) a roll of adhesive foam tape (eg, Engels No. 5 draught exclusion tape). The tape is needed to make airtight gaskets for mounting the drivers on the baffleboard .

Begin by carefully emptying the contents of the long flat box. This must be done very carefully because the top, sides and bottom of each enclosure are in a wraparound piece and held together only by the decorative veneer "hinges" which allow them to be folded. If you are not careful in handling the enclosure in this form you could tear the veneer and spoil the finished result.

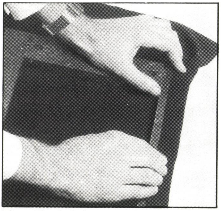
You should also empty the box containing the individual loudspeakers, the crossover networks and the other components, to check that all have been supplied and are in good condition.



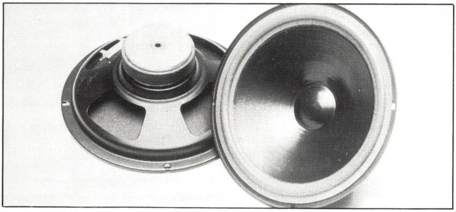
This view shows the assembled cabinet, prior to mounting the loudspeakers.



Take care when mounting the drivers — it's all too easy to punch a hole through a cone.



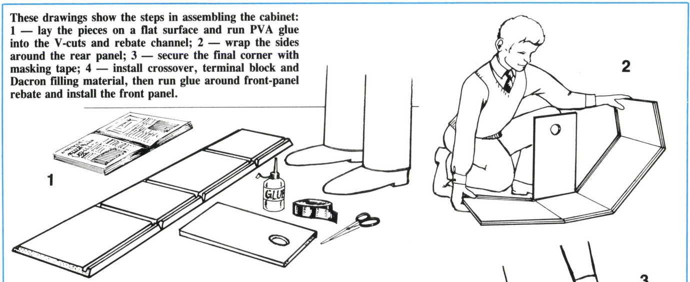
The grille cloth is stretched over the framework supplied and retained with tacks.

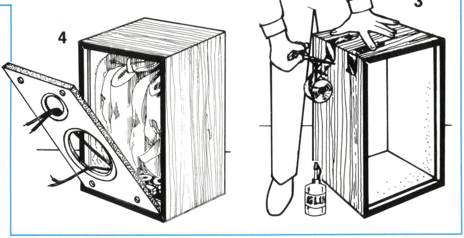


The C20WG-19-08 is a straightforward 200mm woofer with a free-air resonance of 39Hz.

Two-way loudspeakers

These drawings show the steps in assembling the cabinet: 1 — lay the pieces on a flat surface and run PVA glue into the V-cuts and rebate channel; 2 — wrap the sides around the rear panel; 3 — secure the final corner with masking tape; 4 — install crossover, terminal block and Dacron filling material, then run glue around front-panel rebate and install the front panel.





Before starting assembly, it is wise to drill pilot holes for the self-tapping screws. This ensures that they penetrate in a straight line and also obviates the possibility of splitting the timber. The screws are supplied and all are the same size; a 2mm drill gives a suitable pilot hole. Use the actual drivers as a template when marking the holes, but be careful with both to avoid any damage. The screws mount in slots and it's easy to drill the holes too close to the perimeter. This won't allow enough clearance for the screw head.

Recessed terminal blocks are mounted on the back panel. Each requires four mounting screws for which the pilot holes should also now be drilled.

With all the drilling completed, you can proceed with glueing the enclosures. The wraparound member actually folds around the back panel and has a machined rebate to hold the back panel in place. This gives a rigid structure, even before the glue sets.

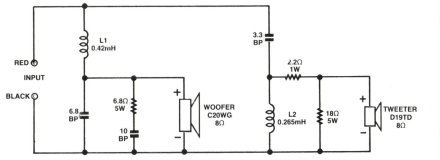
The procedure is quite simple. Lay out the continuous side piece on a flat surface such as the floor or a large table. The three fold joints should be flexed as little as possible, as noted above. Then run a fillet of PVA glue into each of the V-cuts for the three-fold joints and into the rebate channel.

The back panel can now be fitted in to the channel of what will become the base panel. Make sure that the terminal block hole is at the bottom; ie, it corresponds to the join in the veneer which should also be at the bottom. Then it's a matter of carefully wrapping the sides around the back panel, making sure that no stress is placed on any of the three corner joints.

That done, the final corner is held together with strips of masking tape or packaging tape. Don't worry too much if a little glue oozes out onto the veneer. It peels away from the plastic quite easily once it's dry.

Leave the assembly for at least 30 minutes to allow the glue to set and cure.

Each crossover is preassembled on a piece of masonite. This means that they can be glued in position on the bottom of the enclosures. This may as well be done now so that the glue can be drying at the same time as the back panel. Take a note of the connections for the



L1 = 108T, 1mm ENAMELED COPPER WIRE ON A 27mm DIA x 18mm WIDE FORMER

L2 = 86T, 1mm ENAMELED COPPER WIRE ON A 27mm DIA X 18mm WIDE FORMER

VIFA 60-60

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This diagram shows the winding details for the two air-cored inductors.

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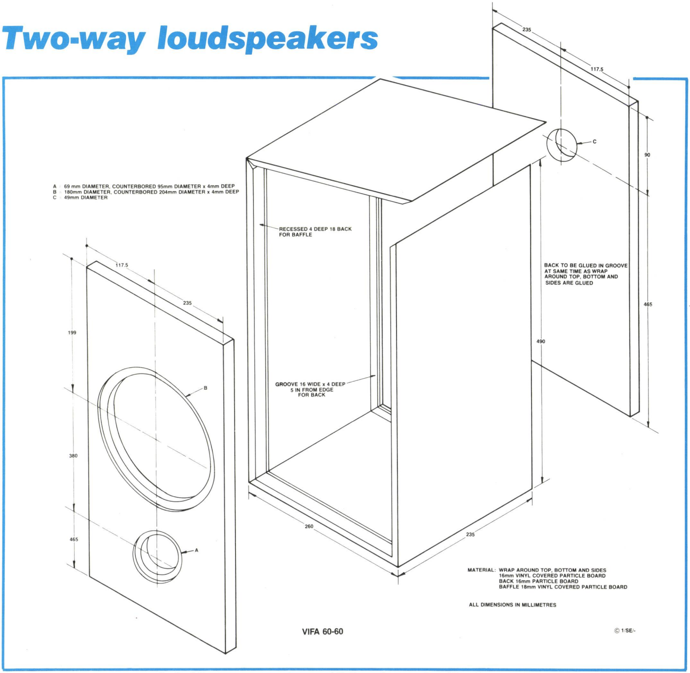
Two-way loudspeakers



235
117.5
C
90
A 69 mm DIAMETER, COUNTERBORED 95mm DIAMETER x 4mm DEEP
B 180mm DIAMETER, COUNTERBORED 204mm DIAMETER x 4mm DEEP
C 49mm DIAMETER
RECESSED 4 DEEP 18 BACK FOR BAFFLE
117.5
235
BACK TO BE GLUED IN GROOVE AT SAME TIME AS WRAP AROUND TOP, BOTTOM AND SIDES ARE GLUED
465
199
490
B
GROOVE 16 WIDE x 4 DEEP 5 IN FROM EDGE FOR BACK
380
465
A
260
235
MATERIAL: WRAP AROUND TOP, BOTTOM AND SIDES 16mm VINYL COVERED PARTICLE BOARD
BACK 16mm PARTICLE BOARD
BAFFLE 18mm VINYL COVERED PARTICLE BOARD
ALL DIMENSIONS IN MILLIMETRES
VIFA 60-60
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You can save even more money by building your own enclosures. All dimensions are in millimetres.

respective terminals on the crossover; ie, input, bass and treble.

Meanwhile, the grilles can be prepared. A framework is supplied, over which the screen cloth must be stretched. As each side of the cloth is stretched and folded into position, it can be retained with tacks. We used a rather slower process of first glueing one side, waiting for this to dry then stretching and sticky taping, glueing the opposing side, and so on. Only the corners were tacked.

The grille cloths are supplied rather oversize. When they are fixed in place, you should trim off the excess. Be sure to uncover the grille mounting holes. There is one in each corner — they are about 12mm diameter. A special plastic clip is inserted into each. The mating half of each clip is mounted in the front panel of the enclosure. They can be inserted now. A gentle tap with a hammer may be needed.

Assuming that the cabinet has been sitting for half an hour or so, fit the terminal blocks and solder them to the crossovers. Dacron filling material has been supplied, enough to half-fill each cabinet. This can be put in now.

The front panel can now be fitted. This is rather simpler than the back panel — it just slides into the rebated front of the box. Run a bead of glue around the perimeter of the box first. Use a generous squirt of glue because it has to give the front panel an airtight seal. Leave the whole enclosure for another half hour or so, to again let the glue dry.

After the requisite drying time has passed, the drivers can be mounted. Solder their terminals first, paying particular attention to polarity and making sure that you don't transpose the woofer and tweeter connections. If you make a mistake here the speakers will sound odd indeed.

Then it is a matter of fitting the grilles onto the enclosures — just push them on — and you are finished. Connect them up to your amplifier, select your program and settle back to enjoy the sound. EA

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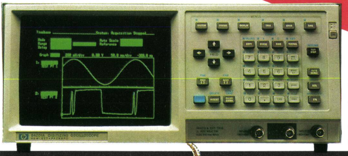

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Toshiba XR-P9RC personal CD player

Toshiba have now entered the competitive personal portable CD player market with their natty-looking XR-P9RC. It can be used simply as a personal player or incorporated into a hifi system and then provide the luxury of infrared remote control.

Toshiba's approach to the design of a personal portable CD player is quite different from the units already in the marketplace. The latter are very compact but basically similar in approach, being essentially a square box of minimum size with very small operating controls.

By contrast, Toshiba have recognised that buyers of a personal CD player will want to integrate it with their main hifi system as well as using it away from home for headphone listening. Accordingly, while the basic player module is a fairly compact low profile case with most controls along the front of the top surface, its presentation when used at home is quite different.

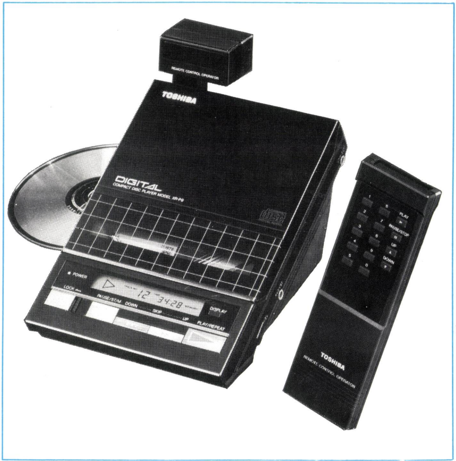
To this end, the XR-P9 is supplied with a clever mains power unit which clips underneath the basic player to make it into a wedge-shaped unit which is very easy to use. In this format, the controls and LCD readout are at a much better angle for the user to see and manipulate. To top it off, a little remote control sensor module is plugged into the top of the XR-P9 to enable remote control via the separate handset. It looks natty indeed.

As a conventional player, the XR-P9RC has all the features that you would expect such as program and repeat, fast forward/reverse and up/down track search.

For use away from the hifi system and from mains supplies, a battery pack clips onto the end of the player. The whole unit is then inserted into the carry case making it suitable for use virtually anywhere. Toshiba claim nine hours of continuous use from six "C" size alkaline cells.

Two audio outputs are provided on the XR-P9 player, both of which are 3.5mm plug sockets. One is for the headphones and is controlled by the adjacent thumb-operated volume control, while the other is for the feed to an external stereo amplifier. With this in mind, Toshiba have included a lead fitted with a stereo 3.5mm plug on one end and two RCA plugs on the other.

The one possibility that Toshiba have not provided for is the use of the XR-P9 in a car. While it has the stereo output lead mentioned above, it does not have an optional DC adaptor to enable it to be used in a car, and to be inte-



grated with the car's existing sound system. We think that many potential users would be attracted by this idea and it has the additional advantage that the CD player need not be left in the car, which lessens the possibility of theft.

Operation

Six switches below and beside the liquid crystal display control the player. The Open switch releases the lid so that it can be swung up and a disc inserted. If you are on the move and don't want the disc to fall out accidentally, you can lock the lid shut by means of a plastic slider next to the Open switch. The fact that the lid is locked is then indicated on the liquid crystal display (LCD).

The Play/repeat pushbutton at the right hand side of the control panel is used to start disc play. Play status is indicated on the LCD by a triangle symbol. If Play is pressed twice, the word "repeat" is indicated in the LCD and the disc will repeat play continuously.

Play can be stopped by pressing the Pause/Stop/memory switch. Pressing it once pauses the machine (indicated on the LCD by the flashing parallel vertical bars), while pressing the Play switch will start play again. Pressing the Pause/stop switch twice stops the player completely.

The Skip Up and Skip Down switches are also multifunction switches. When pressed, they will send the player to the beginning of the next or previous track. However, when pressed in conjunction with the Play/Repeat switch, they initiate fast forward or reverse.

Apart from the above mentioned annunciators, the LCD also indicates track number and time. It can show either the track being played or alternatively, the remaining number of tracks on the disc. Similarly, the time indication can show elapsed track playing time or remaining disc playing time. The display mode is selected with the switch located to the right of the LCD.

The program function is capable of playing up to 16 tracks in any order but this facility is only available when using the mains power pack.

The remote control handset includes buttons for play, pause/stop, up and down skip plus numeric keys from 0 to 9. The numeric keys allow selection of any track from 1 to 99, depending on how many tracks are on the disc. Track access time is fairly brisk, averaging about two or three seconds.

As far as using the Toshiba is concerned, it must be rated as a fun instrument. Its novel presentation certainly helps here and all who passed by the writer's office while this review was being prepared agreed that it was a most attractive unit.

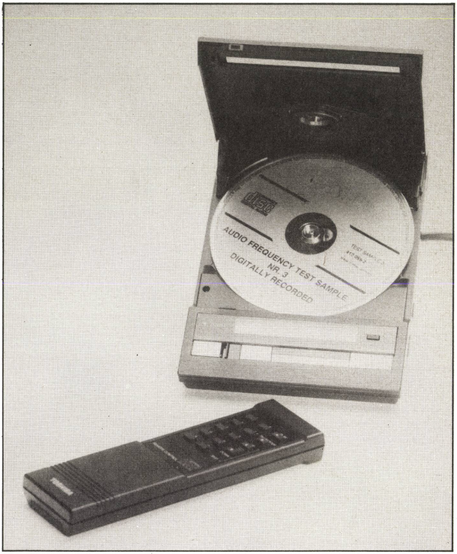
Performance

We tested the performance of the XR-P9 using the Technics SH-CD001 test disc. The TAC-P9 power supply was connected and the results were measured using our Sound Technology audio noise and distortion meter.

Frequency response was found to be −1dB down at the extremes of the audio band, at 20Hz and 20kHz. This is flatter than most CD players achieve and probably points to gentle analog filtering of the audio output.

While such filtering is very effective at obtaining a very smooth frequency response it does mean that inaudible frequency artefacts of the sampling process will be present in the output. These residual high frequency components are, of course, inaudible but they make it difficult to measure harmonic and total harmonic distortion, as we found.

Our figure for total harmonic distortion at 20Hz was .018%, rising to .027% at 1kHz and .03% at 10kHz. Measurement at 20kHz was difficult due to the sampling artefacts remaining in the distortion component. While this distortion measurement is certainly higher than Toshiba's claimed figure of



The lid of the XR-P9 opens wide to accept the disc.

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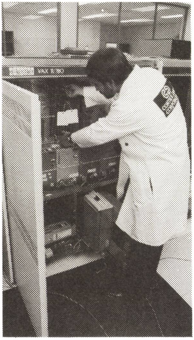

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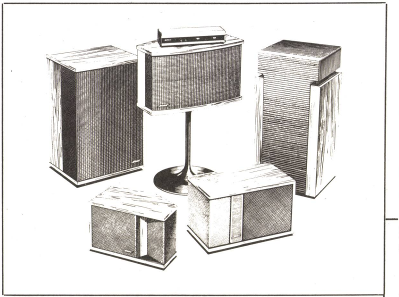

less than .01% at 1kHz, we have no reason to doubt that the "true" harmonic distortion is close to Toshiba's figure.

Intermodulation distortion (IMD) was also measured and resulted in a reading of .045% which is an indication that, in reality, the distortion performance of the XR-P9 is on a par with normal CD standards.

Signal-to-noise (S/N) ratio measurements on the Toshiba portable are not quite as good as we have come to expect with CD players though. Toshiba claim a figure for the S/N ratio of 84dB which can be achieved with the battery supply. But when used with the clip-on mains adaptor this falls to 71dB. Most of this noise is hum, which is not surprising considering the close proximity of the mains power transformer.

The noise is audible if you listen on a pair of sensitive headphones with good bass response and with the level control wound all the way up but this is not a realistic way to listen to any CD player. If you were to do so, your ears would be blown off as soon as the music started.

Linearity of the player was also measured. This involves comparing the output level with diminishing levels from the test disc. The results showed a −1dB error at the −60dB level and +2dB error at the −70dB level. At levels below these the residual noise of the player masked the measurement.

Separation between channels was checked and resulted in readings of −70dB at 100Hz, −71dB at 1kHz, −58dB at 10kHz and −52dB at 20kHz. Again, these figures are not quite as good as conventional CD players but are on a par with Toshiba's claims and, in fact, are more than adequate for high quality sound reproduction.

Tracking of the XR-P9 was tested using the Philips 4A test sample disc. For the interruption layer test, the player tracked without audible disruptions up to the 700μm length interruption. At the 800μm interruption we noticed audible dropouts occurring.

Using the black dot test, the player similarly behaved well up to the 800μm dot whereupon it began repeating tracks. The simulated fingerprint gave no audible problems for the player. While this is not a perfect score, it does mean that the player could be expected to play all discs except for those with quite noticeable surface blemishes.

Resistance to vibration and movement is also satisfactory, without being exceptional. You could happily use the player while walking but whether it would tolerate jogging is another matter. It's a little heavy for that anyway, when used with its battery pack.

Overall, the XR-P9RC personal CD player must get the nod for its very attractive presentation and its remote control feature. No other portable has it. Everyone who saw and listened to it during the preparation of this review was impressed. So were we. It does not have quite the performance standard that most conventional CD players provide, but its portability and versatility more than make up for this.

For those who want a portable CD player which can also be used at home with the hifi system, this is a system to check out.

Recommended retail price of the Toshiba XR-P9RC is $529. See it at your local hifi outlet. (J.C. & L.D.S.).

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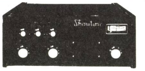

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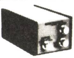

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More channels for the Explorer UHF transceiver

Extend the frequency coverage of your DSE "Explorer" UHF amateur transceiver. This simple circuit is based on a single CMOS IC and adds 40 channels in the region from 439 to 440MHz.

by GLENN PERCY, VK3PE

In Victoria and, no doubt, in other States, a number of commonly used channels exist in that portion of the amateur UHF band from 439.000 to 440.000MHz. As it stands, the Dick Smith *Explorer* cannot easily take advantage of these channels due to the restricted coverage provided in the original design (438.025 to 439.000MHz).

To overcome this limitation, it was decided to modify the circuit to provide full coverage of the UHF FM Amateur band while still retaining the original 40-channel switch, as an 80-channel switch would be unprocurable. Thumbwheel switches were rejected on the grounds of cost, fitting difficulties and more complex interfacing requirements.

The method adopted involves combining two user-selectable ranges with the original 40-channel switch, thus providing the full 80 channels (ie. from 438.025 to 440.000MHz). The two ranges are selected by a new SPDT toggle switch mounted in a convenient position on the front panel of the *Explorer.* This switch is connected to a 4008B 4-bit binary adder CMOS IC which is interposed between the 40-channel switch and the PLL IC (PLL02A) in the *Explorer.*

The Explorer UHF amateur transceiver originally covered 40 channels from 438.025 to 439.00MHz.

How it works

The simplest method of explaining the operation of the adder is to calculate the binary input required to the PLL02A PLL IC in the *Explorer.* This binary number represents the division ratio, usually referred to as 'n', and in the *Explorer* may be derived from the formula:

$$n = \frac{(f/3)-143.58333}{0.008333}$$

For example, if we choose channel 1, or 438.025MHz, then n = 291. In binary, this is 100100011. This is the bit pattern required from the 40-channel switch in the channel 1 position. If we now wish to select 439.025MHz, or channel 41, we obtain a value for 'n' of 331 or 101001011 in binary. The channel switch should thus be set to channel 1 where n = 291 and 40 must be added, ie. 291 + 40 = 331.

In other words, we must add the binary equivalent of 40, or 0101000, to the output of the 40-channel switch and then present this new binary number to the PLL:

$$\begin{array}{rr} \text{Ch1} = 291 & 100100011 \\ \text{plus } 40 & \underline{0101000} \\ = & 101001011 = 331 \end{array}$$

The two most significant bits are actually hardwired to the PLL02A in the *Explorer,* so we are left with 1001011. The three least significant bits to be added are all 'zeros'. We may delete them, to simplify the circuitry, since the 4008B IC used is only a 4-bit adder. Hence, in the circuit, it can be seen that these lower three bits are in fact passed straight through to the PLL and only the upper four bits are manipulated to obtain the additional 40 channels.

Since this adder circuit is always connected between the 40-channel switch and the PLL02A, you may ask how we obtain the standard 40 channel output from the switch. What we do, in fact, is to simply add "0" or 0000 in binary to the 40-channel switch.

Switch S1 is used to select between the lower and upper 40-channel ranges by switching +5V to pins 3 and 7 of the 4008B adder. In the lower 40-channel position, pins 3 and 7 are pulled low by a 100kΩ resistor and 0000 is added to the 40-channel switch. In the upper 40-channel position, pins 3 and 7 are pulled high and 0101 (40) is added.

Construction

Although the extra circuitry involved is minimal, practical implementation requires access to the output pins of the 40-channel switch so that they can be connected to the adder circuitry. In the prototype, this was achieved by carefully removing the switch from the PCB, rotating it by 90 degrees and soldering a small PCB, containing the new circuitry, to the switch pins.

Note that the front panel must be desoldered first to allow removal of the 40-channel switch. Solderwick or a solder sucker will simplify removal of the switch. The LED indicator must be removed also.

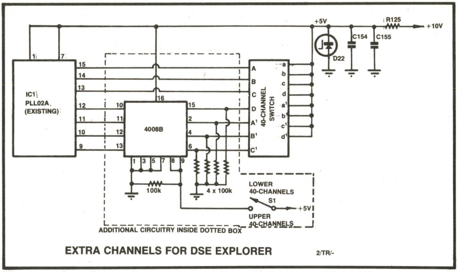
After cleaning any solder dags from the switch pins, the 40-channel switch should be put aside while the PCB is assembled. This involves fitting of the insulated link, the resistors and finally the IC. Standard precautions should be taken since this is a CMOS device. Finally, the connecting wires should be fitted and the PCB fitted to the 40-channel switch.

A 6mm hole should now be drilled in the front panel for the range toggle switch. This may be mounted in any clear position on the panel. In the prototype, it was mounted adjacent to the microphone socket.

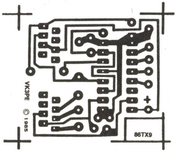
The front panel may now be refitted to the *Explorer*. Connections to the *Explorer* PLL02A may be made either directly to the pins or, for the purist, new holes may be drilled through the tracks leading to the pins to accept the necessary leads. Additional leads should then be run to the new range toggle switch and the +5V and ground connections.

Once all connections have been checked, the *Explorer* may be switched on. The lower 40-channel position should be selected with the toggle switch and your favourite channel tried. This should function normally. If not, check connections and +5V power to the new PCB.

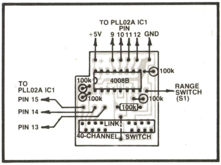
When all is OK, select the upper range and check the performance of the unit with an amateur who has these channels available. Note that a slight readjustment of the VCO coil may be required to maintain PLL lock over the extended frequency range now provided. No problems were experienced on the two units tested.



The extra channels are obtained by installing a 4008 binary adder IC between the PLL IC in the 'Explorer' and the existing 40-channel switch.



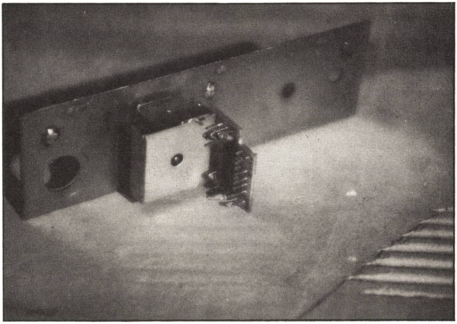
Here is an actual size PC artwork.



Above: parts layout diagram for the PCB.

PARTS LIST

1 4008 4-bit binary adder IC
1 PCB, code 86tx9, 33 x 36mm
1 SPDT toggle switch
5 100kΩ 0.25W 5% resistors
10 PC stakes



This photograph shows how the PCB is supported on the 40-channel switch.

Upgrading the 1980 Eprom programmer

Do you have a July 1980 EA EPROM Programmer? If so, don't give it the boot. This article shows how to adapt it to program 2732A, 2764 and 27128 EPROMS.

by J. C. HOLLIDAY

Those people who constructed the EPROM Programmer described in July 1980 are probably wishing technology wouldn't advance so quickly.

The original EPROM Programmer allowed for the programming of 2708, 2716 and 2732 EPROMS but it wasn't long before 2708s became extinct and were replaced with larger memory types such as the 2764, and 27128. As an added bonus these larger EPROMS are easier to program.

This project will give a new lease of life to your old EPROM Programmer and will allow you to program most of these newer EPROMS. The modifications require only a handful of readily available parts and a little of your time.

The first task is to replace the 24-pin zero insertion force (ZIF) socket with a 28-pin version which is necessary to accommodate the larger EPROMS. If you're good at desoldering 24-pin IC sockets without wrecking the PC board then go ahead.

You will find there is enough room to the left of the present ZIF socket to drill the four extra holes needed. This would probably be the neatest solution and would also be best for those constructing the project from the beginning.

I must confess that I was daunted by the task of removing such a big socket and so I devised an alternative which may appeal to like minded people. Solder the respective pins of the 28-pin ZIF socket to a 24-pin header leaving four pins (1, 2, 27 and 28) of the socket unsoldered. The header can now be inserted into the existing 24-pin ZIF socket with these four unsoldered pins to the left.

The necessary connection to pins 1, 2, 27 and 28 can be made through a small hole drilled at a convenient point in the front panel (eg, between "O" and "M" in the word EPROM).

Pin 26, which is the Vcc pin for 2732 and 2716 EPROMS, the A13 pin for 27128 EPROMS and unused in 2764 EPROMS, needs a flying lead to connect it to S1d. The copper track which formerly connected pin 26 permanently to the +5V supply line has to be cut.

When using this new socket with 24-pin EPROMS, the devices must be inserted so that they occupy the extreme right position in the socket with pin 1 positioned towards the lower left. EPROMS with 28 pins are just inserted as usual, with pin 1 at the lower left.

Switching

Whilst you are drilling the front panel you should also drill a hole to mount S3, an SPDT toggle switch. This should be mounted on the front panel level with S1 and midway between S1 and the right edge of the panel.

Switch S2 is used to provide the different voltages for the PROGRAM and READ modes for the various EPROMS. Because of the widely differing EPROMS now being catered for, this switch needs more positions.

S2 has to be replaced with a 4-pole 2-position toggle switch (Dick Smith catalog S1175 is ideal). Whatever replacement you use, be sure it is a "break before make" type. Many of the new wafer or rotary type switches are "make before break" and are definitely unsuitable for this position.

You have only to examine the function of S2d and see that it is switching between 5V and 25V power supplies to appreciate the likely damage that can be done if these two supplies are momentarily connected together.

S2 can be mounted in the same position without any alteration to hole position or size.

Referring to the circuit diagram you may observe that all wiring relating to the 2708 function has been deleted. This frees position 1 on S1 which is now used for 2764/27128 switching functions.

Even though S1 is the original switch, I feel it wise to ensure it is a "break before make" type also.

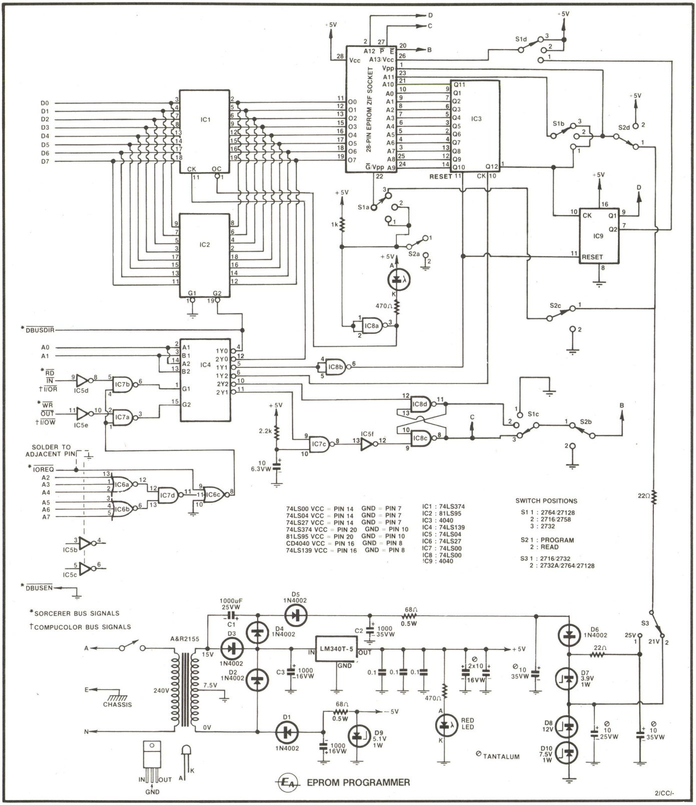
Whilst the wiring for the 2708 has been removed from S1, there is no need to remove the 2708-related components from the PC board.

Wiring to the other S1 positions remains largely intact, but there are minor alterations and you should carefully check all S1 wiring against the circuit diagram.

Programming voltages

One obvious difference is the inclusion of S3. The purpose of S3 is to provide a choice in programming voltage. Some EPROMS, such as the 2716 and 2732 require a 25V programming voltage, whilst others, such as the 2732A, 2764 and 27128 require only 21V. To provide these voltages, D7 has been replaced with a 3.9V zener diode, and an additional 7.5V zener diode (D10) connected between D8 and ground.

This should provide the desired voltages of 21V and 25V, but due to com-



EA EPROM PROGRAMMER

ponent tolerances you should accurately measure these voltages to ensure they are correct. You may have to experiment a little with a couple of different zeners until the voltage is correct. According to the data sheets the voltages should be within ±0.5V.

After wiring the switches, the only remaining alteration required is to add IC9, an additional 4040 counter. The existing 4040 counter is a 12-bit binary counter which is adequate for handling the 11 address lines of a 2716 or the 12 address lines of a 2732. It cannot service the 13 address lines of a 2764 or the 14 address lines of a 27128.

The new 4040, which derives its clock input from the Q12 line of the existing 4040, continues the counting process to the higher address lines.

One advantage of this addition is that even higher address lines are available should expansion to a 27256 be considered.

Eprom Programmer

The easiest way to install IC9 is to solder pins 8, 11 and 16 directly to the corresponding pins of the existing 4040. All the remaining pins of IC9 should be bent up so that they do not contact any of the other 4040 pins. Flying leads can then be used to connect pins 9 and 7 of IC9 to the appropriate places.

Before using the EPROM Programmer in its new form you should check the wiring by noting the voltages which appear on the EPROM socket pins in both the READ and PROGRAM modes. The following table is a guide. Note that all pin numbers refer to the new 28-pin socket.

Software

Software to drive the EPROM programmer consists of a main program written in BASIC which calls subroutines for the various functions. The main program is written for a System 80 or Tandy Model 1 personal computer running under NEWDOS/80 Version 2.0, but the program can be easily adapted to run on other machines.

Subroutine 2 allows data entry from the keyboard into memory, subroutine 6 allows editing of memory, and subroutine 3 lists the data stored in memory. These subroutines are in BASIC and are adapted from the original article. All input and output from these routines is in hexadecimal format.

Because of the larger EPROM sizes, listing of data is not recommended because of the longer time involved. On the other hand, there is not much point in speeding up the output by using a machine code subroutine because then you wouldn't be able to read it.

A much better way of examining large tracts of memory is to use the DEBUG facility of NEWDOS.

When entering or editing data, memory is assumed to start at 0000H and finish at the appropriate number for the EPROM (0FFF for a 2732, 1FFFH for a 2764 etc). In the computer, this data is actually stored starting at 8000H and continuing as far as FFFFH. Hence there is sufficient memory to store up to 32K of data, enough for a 27256.

The machine code subroutines occupy memory from 7F00H to 7FFFH. This memory for data and machine code must be protected from being written over by BASIC and so, when entering BASIC from DOS, you must reserve this area by typing BASIC 32000. This forces BASIC to use only that area of memory below 7F00H.

Subroutine 1 is an erasure check; subroutine 4 programs the data stored in memory into the EPROM; subroutine 5 reads data from an EPROM into memory; and subroutine 7 compares memory data with EPROM data, stopping when it meets the first discrepancy and printing out where the discrepancy occurred.

Subroutines 1, 4, 5 and 7 are machine code subroutines and are executed very rapidly. This is virtually a necessity when dealing with 2764s and 27128s.

A listing of the machine code subroutines shows the memory location of the instruction in column 1 and the sequence of machine code instructions in column 2. These may be helpful to those who use BASIC to POKE a machine code subroutine into memory.

The easiest way, however, is to use an assembler and the remaining columns give the assembly language mnemonics. These should be common to most machines using a Z80 microprocessor.

S1 position	Mode	Pin 1	20	22	23	27	28
1 (2764/27128)	read	5	0	0	★	5	5
	program	21#	0	5	★	H	5
2 (2716)	read	–	0	0	5	–	–
	program	–	L	5	25#	–	–
3 (2732/2732A)	read	–	0	0	★	–	–
	program	–	H	25/21#	★	–	–

Notes: (1) – No effect
(2) ★ An address line, could be logic high or low
(3) H Logic high, pulsed low for 50ms by programming software
(4) L Logic low, pulsed high for 50ms by programming software
(5) # selectable using S3

EXTRA PARTS REQUIRED

- 1 28-pin ZIF socket
- 1 4040 12-stage counter IC
- 1 7.5V 1W zener diode
- 1 3.9V 1W zener diode
- 1 4-pole 2-position switch
- 1 single-pole 2-position switch
- 1 22Ω 0.25W 5% resistor

What will be machine-dependent is the generation of the 50ms timing pulse which is required during the programming cycle. This pulse is obtained by repeating the sequence of instructions from line 190 to line 220 a total of 3235 times.

My microprocessor runs at 1.747MHz so the time for one clock cycle is 1/1.747 or 0.5724 microseconds. The set of instructions in the timing loop requires 26 clock cycles, so the time required for 3235 executions of this loop will be: 3235 x 26 x 0.5724 = 48,145 microseconds = 48.145ms.

This is within the 50 ±5ms limits. The figure was deliberately chosen to be on the low side to minimise stress on the EPROM during programming.

You can determine for yourself how many times the timing loop needs to be repeated by substituting the clock speed of your own computer in the calculation above.

The only other feature deserving comment is the time delay from lines 162 to 168. These weren't necessary when the programmer was used as originally intended for EPROMS no larger than 2732s. However, when using 2764s I noticed that location 1000H was often misprogrammed.

This is where the second 4040 counter first starts to count. The misprogramming is thus probably due to the extra time delay introduced by the second 4040 being clocked by the first. The time delay introduced into the program compensates for this effect.

That completes the description of the modifications required. When larger EPROMS appear on the scene, provided they are programmed in the same way, all you'd need to do is get an even bigger ZIF socket and connect the new address lines to the appropriate pins of the new 4040.

Note: a full software listing can be obtained by sending an SAE, together with $2.00, to *Electronics Australia,* PO Box 227, Waterloo 2017.

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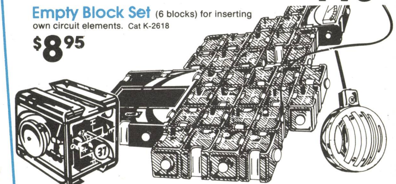

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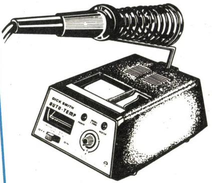

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Cat T-2000

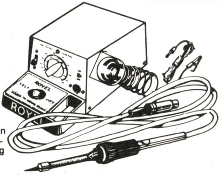
Versatile 12V Soldering Iron

When you need more power for electrical work this heavy duty iron delivers a full 30W. Use it around the home, professional workbench or on the car (comes with cigarette lighter plug). Lightweight, balanced design is ideal for PCB work too! Operates from any 12V supply (AC/DC). Cat T-1910

ONLY $6^{50}

NEW! Royel Professional Vari- Temp Soldering Station

Precise Temperature Control!



Your passport to professional soldering. A state-of-the-art station that allows variable temperature control for a variety of applications — ideal for expensive circuits. Temperature sensor located right behind the tip to accurately maintain desired heat level. Features electro-static shields, zero voltage switching and much more. Cat T-2050

GREAT VALUE!

ONLY $169

Accessory Tips

Fine.
Cat T-2051
Medium (Standard)
Cat T-2053
Large Bevel
Cat T-2054

ONLY $5^{95} ea

DICK SMITH ELECTRONICS

ARLEC SUPER TOOL

The one tool you should own because it does so much! It polishes... cuts... engraves and erases... even mills. All parts are included, plus 240V plug pack adaptor. Hobbyists, handymen and tradesmen can use it for all those jobs that usually require buying two, three or more different tools: save $$$! Cat T-4754

ONLY! $62^{75}

Bonus: Super Tool Carry Case included! Arlec Accessories

Wire Brushes

Pack of three brushes for polishing PCBs, jewellery, brass ornaments, etc. Cat T-4768

ONLY $16^{45}

Erasers

Quickly and thoroughly erases ink from plans and diagrams. Perfect for the office and that professional touch at home. Cat T-4760

ONLY $4^{15}

SOLDERING ON AT DSE...

Mini Soldering Iron for precision work

Don't make a mess of it! Our ultra-slim iron is perfect for precision soldering on computers, PCBs and auto repairs (optional cigarette lighter plug available). Heats quickly. 6W output, 12V AC or DC operated. Cat T-1920

$16.95

Replacement Tips

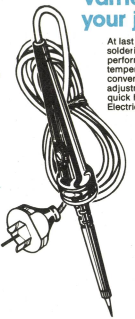
Copper Wedge. **$3.25**
Cat T-1921

Copper Conical **$3.25**
Cat T-1922

The heat's on! varitemp iron for all your jobs.

At last an affordable variable temperature soldering iron to handle the heat of performing all those jobs requiring different temperatures. Temperature control is conveniently located in the handle for easy adjustment. Powerful 25W capa and quick heating performance. 240v operated, Electricity Authority approved. Cat T-1350

$32.95



Spare Tips

Medium. Cat T-1351
Large. Cat T-1352
Conical. Cat T-1395

$4.35 each

Don't be a sucker!

A quality, metal solder sucker like this would cost twice as much anywhere else. And our low price isn't the only thing to please. The sucker features a Teflon tip with simple thumb release mechanism for easy solder removal. Cat T-2560

ONLY **$12.65**

Your third hand... a solder stand!

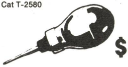
DUE LATE SEPTEMBER

$43.95

You always wish for another hand when soldering PCBs... Here it is! Just place board in rubber faced vice, adjust angle, and secure. Iron and solder spool holder means they're always close at hand. Cat T-5700

Easy Desoldering!

Desoldering Bulb is simple, quick and very efficient. Hold Bulb to molten solder, squeeze and release: solder is sucked up instantly. Ideal for blow cooling too. Cat T-2580



ONLY **$9.85**

Desoldering Braid

Famous 'Dick Wick' — treated copper braid that quickly and thoroughly removes solder by capillary action. On economy reel — use only what you need! Cat N-1682

$3.15

Economy Solder Packs: 'project' sized!

Just what the hobbyist ordered: a liberal amount of solder in very affordable packs. Available in two sizes:

1.25mm (18g). Cat N-1638
0.75mm (22g). Cat N-1636

Only **$2.15** each

Soldering Stand/ Magnifier

The perfect accessory! Sturdy soldering stand features clips for holding PCBs, etc. Invaluable magnifying lens for delicate work too! A must for every bench. Cat T-5710

GREAT VALUE! **$14.25**

Bargain corner these items must go!

(UP TO 60% OFF!)

Metric Knobs
Red, plastic; 16mm Cat H-3800
Orange, plastic; 16mm Cat H-3802
WAS $1.55 **75¢ ea**

RCA Metal plug; red.
Cat P-1424
WAS 95¢ **50¢**

OP-AMP Experimental PCB. Suits 741 type op-amps with provisions for circuit variations: input, feedback, etc.
Cat H-5618
WAS $4.95 **$2**

N connector; female line; silver plated. Cat P-2405
WAS $7.95 **$4.95**

DPDT Mini toggle switch; right angled.
Cat S-1177
WAS $2.50 **$1.50**

BP (mains) connectors; 240V. Pk. of 10. Cat H-6710
WAS $2.75 **$1**

Wire Stripper/ Wrapper

You don't have to spend a fortune for professional wire wrapping. Our simple, economic tool does a great job and strips wire too! Add it to your tool box today. Cat T-3650

BARGAIN AT ONLY **$15.35**

DICK SMITH ELECTRONICS
FLUX REMOVER
A POWERFUL SOLVENT DESIGNED FOR REMOVAL OF FLUX AFTER SOLDERING
SUITABLE FOR CIRCUIT BOARDS ETC
Cat. N-1055

Give flux removers the can!

The fast, efficient way to clean up messy solder jobs is with spray flux remover. It's perfect for service work and projects. 400g spray can. Cat N-1055

GREAT VALUE! **$10.95**

DICK SMITH ELECTRONICS
PTY LTD

LIMITED STOCKS... HUGE SAVINGS...

50% Off Book Sale! And what a choice...

Motorola RF Products Databook. Everything you've wanted to know about Motorola's RF devices: from small signal to power amps... and much more! Cat B-4035
WAS $24.50 $11.25

How to tune the Secret Shortwave Spectrum. Tune into the hush-hush frequencies that aren't printed. Hear military, Government and even espionage gossip. This book tells you how! Cat B-1649
WAS $18.65 $8.45

Australian Marine Radio Handbook. A 'must' for all boat owners! Tells you how to choose, install and use marine radio PLUS essential details for every Salt. Cat B-9604
WAS $4.95 $2.45

Philips General Catalogue: Considered the Bible of Electronics. 568 Pages of ICs, semiconductors, components... the lot. Everything a hobbyist needs. Cat B-4010
WAS $13.95 $6.25

Tricks & Experiments. Ideal book for all students of science, packed with 333 exciting experiments: gasses, chemistry, light and much more. Cat B-1730
WAS $19.95 $9.25

More Scientific Tricks. Builds on to the first edition (above) with a brilliant selection of experiments. An excellent publication that gives students the edge at school. Cat B-1735
WAS $19.95 $9.75

Digital ICs & LEDs. Superb source book that teaches important fundamental circuit concepts, how to build digital devices and handy troubleshooting hints. Cat B-1785
WAS $21.45 $10.70

Laser Technology. Brilliant source book that covers laser radiation, construction, design and more! All the principles and practical information hobbyists and technicians require. Cat B-1861
WAS $32.95 $14.95

Complete Guide to Satellite TV. Everything you've ever wanted to know about Satellite TV is in this book! Choosing equipment and setting up a station... orbit link-ups and down-link specs, etc. Cat B-1841
WAS $20.45 $9.95

Motorola Small Signal Products Databook. All the JEDEC types plus Motorola's house branded small signal transistors. Cat B-4036
WAS $27.95 $12.75

Value! Metric Screw Packs

Always handy around the workshop. Generous pack of 150 assorted self-tapping, counter sunk screws. Cat H-1505
WAS $3.50 $1.50

Assorted pan head machine screws in a beaut 320-pc. pack for all those jobs that always come up. Cat H-1510
WAS $5.95 $2.95

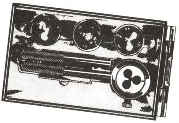
Secure cables easily!

Heavy-duty cable clamps for a variety of service and hobbyist uses. Bargain priced pack of 5. Cat H-1972
WAS $2.50 $1

Near ½ price! Metric Die Set

SAVE $14

Value! 6-pc. die and stock set. Contains: 2mm, 3mm, 4mm and 5mm dies PLUS a handled stock. All in a convenient case with full instructions. Cat T-4905
WAS $29.50 $15.50



More Metric Screws...

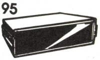
Value! Pack of 160 assorted pan head screws... handy to have around! Cat H-1500
Normally $3.50 per pack
Now $1.50

Die-Cast Aluminium

Versatile project box with all the benefits. Channelled walls for PCB mounting; ideal for RF circuits as lid forms a screen. Perfect for heat orientated circuits... aluminium makes a heatsink. Withstands high temeratures: up to 600° C. 150x50x80mm. Cat H-2206
Normally $10.50 $7.50

$10 Off! Plastic Case

Take all the features a hobbyist would want and this is it: The Case! PCB mounting slots and posts, transformer mounting posts, ventilation and speaker slots... the lot! Huge size: 250x190x80mm. Cat H-2507
Normally $19.95
$9.95



Hey! We're Crazy with Metric Screws...

Bargain pack of 270 assorted, counter sunk machine screws. Cat H-1515
Was $5.95 $2.50

...And Metric Nuts too!

Bolt in for this bargain! Pack of 150 assorted nuts in popular sizes. Cat H-1520
SAVE $4 $3.50

Metric Washers

You've got the nuts, the screws and the bolts... so now you've got the washers: pack of 680 assorted. Cat H-1525
WAS $7.50 $3.50

COMPONENT SAVINGS UP TO 80% OFF

DESCRIPTION	Cat No.	NOW	WAS
Ceramic Cap. 50V 12pF	R-2237	1c	15c
Electro Cap. RB 10V 33uF	R-4330	5c	65c
Electro Cap. RB 10V 470uF	R-4407	5c	65c
Resistor PW5 W/W 820 ohm	R-1672	15c	55c
Electro Cap. 16V 22000uF	R-4575	$2.50	$12.50
Electro Cap. 10V 100uF	R-4125	15c	45c
Green Cap. 100V 5PT 0.047uF	R-2080	10c	27c
Electro Cap. RB 25V 2.2uF	R-4300	10c	25c
Electro Cap. RB 25V 22uF	R-4319	10c	27c
Electro Cap. RB 25V 47uF	R-4350	10c	32c
Electro Cap. RT 16V 10uF	R-4055	10c	35c
Electro Cap. RP 80V 2500uF	R-4572	$1.80	$3.80
Electro Cap. RB 25V 4.7uF	R-4310	5c	25c
Cap 250V 6.5uF	R-2855	$2.50	$5.30
Cap Tant. 10V 33uF	R-4765	50c	$1.05
1K W/W Pot 6mm	R-6915	$3.00	$6.35
Green Cap. 100V 5. PCT .01uF	R-2055	5c	27c
Carbon Pot ¼" SG LIN 500K	R-1812	70c	$1.20
Carbon Pot ¼" SG LIN 10K	R-1806	50c	$1.20

DICK SMITH ELECTRONICS PTY LTD

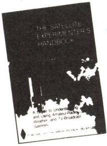
High Gain UHF CB Antenna

Get the most from your UHF base station with this excellent antenna. An impressive 4.5dB gain... for extra range that counts. Cat D-4012

HURRY... LIMITED STOCKS

$25

Satellite Experimenter's Handbook


THE SATELLITE EXPERIMENTER'S HANDBOOK
A Guide to Understanding and Using Amateur-Radio, Weather and TV-Broadcast Satellites

½ Price!
WAS $26.50
Now Only
$13.25

We've come a long way since Sputnik — and now you can be part of the action! Whether you're interested in amateur radio, TV, etc. this superb book contains all the details about satellite communications. Cat B-2235

TAKE ADVANTAGE OF OUR STOCK PROBLEMS!

WHILE STOCKS LAST

Save Over $600

Was $2120

Extend earthly 2m, 70cm and 6m to the exciting world of satellite communications with Yaesu's FT-726 VHF/UHF all mode transceiver. Just install optional IF unit for full duplex crossbanding with independent tuning and mode selection — it's out of this world! Comes complete with 2m band module: 70cm and 6m modules also available.

- **All modes on all three VHF/UHF bands — 6m, 2m, 70cm (with all modules installed)**
- **Full duplex crossbanding with satellite unit installed**
- **10W output on each band**
- **Repeater splits for all bands easily programmed into memory**
- **Dual synthesised VFO's tuning 20Hz/step**
- **Speech processor for SSB**
- **240V AC operated (12V DC with optional power cable)**

Cat D-2950

BARGAIN AT ONLY! **$1500**

1GHz Frequency Counter now $100 off!!

The affordable counter with a professional standard of performance for every workbench: in schools, labs, etc.! And with an impressive range — up to 1GHz — there's no limit to its applications. Check out these superb specs:

- **Large easy to read 8 digit display**
- **Streamlined, functional design**
- **3 gating time — 0.1, 1 & 10 seconds**
- **3 frequency ranges — 10MHz, 60MHz & 1GHz**
- **Sensitivity at 1GHz — 20mV**
- **Inbuilt 10:1 attenuator**
- **Inputs — 10Hz to 60Hz at 1M ohm**
  50mHz to 1 GHz at 50 ohms

Cat Q-1315

Was $539 **$439**

The one tool all Hobbyists need... now nearly ½ price!

Only **$7.50**

Were $14.95

Every workbench and tool box needs one — in fact two or three! The long nose plier is a handy tool for any hobbyist, technician or home handyman. And now DSE's quality stainless steel mini plier is nearly half price... a good reason to add another to your tool box. Heavy-duty serrated jaws offer high gripping power. Fantastic value! Cat T-3565

KITS

Famous DSE Kits are amazing value! By building it yourself, you save $$$... have the satisfaction of saying you did it... enjoy the latest and the best in electronics for a fraction of the price.

Two-Up Game

An Aussie tradition goes electronic! Now play Two-Up without breaking the law by building this fun game. No coins required: it simulates the throw, spin and results. Great fun for the whole family. Cat K-2661

WAS $5.95 **$3.95**

Stereo TV Decoder

Enjoy TV even more, in sensational stereo, without the need to buy an expensive new set. Our easy to assemble Stereo Decoder can be built into your set or fed through Hi-Fi system — providing true channel separation. Includes UHF tuner too! As described in EA Cat K-6325

MARCH '85 WAS $199 **$149**

Binary Bingo

It's fun and educational! The perfect school project that demonstrates binary math... the basis of computers. More than a game, it's a challenge. Cat K-2668

$11.95

FunWay Gift Box

What value! Over $70 worth of electronics excitement for under $60 Includes two projects from each of the three popular FunWay kits PLUS all three FunWay books. Makes the ideal gift for kids of any age. Cat K-2680

$54.95

When the bean counters say "You're overstocked..." Who are we to argue?

DESCRIPTION	CAT NO.	WAS	NOW
Dynamic RAMS:			
4116 (16K x 1)	Z-9310	$3.95	**$1.00**
4164 (64K x 1)	Z-9312	$7.50	**$3.50**
2114 (1K x 4 static)	Z-9306	$3.95	**$1.95**
2732A EPROMS, too!	Z-9209	$7.95	**$3.95**
And 2513 Char. Gen!	Z-9206	$15.95	**$8.95**
WHAT! Not 4000 & 74 C Series CMOS too? Is nothing sacred?			
4001 (Quad 2 in NOR)	Z-5601	70¢	**40¢**
4044 (Quad NAND r/s latch)	Z-5644	$2.25	**75¢**
4518 (Dual BCD Up count)	Z-5740	$2.15	**75¢**
74HC85 (4 bit mag comp)	Z-5885	$2 50	**75¢**
74HC165 8 bit shift reg	Z-5930	$3.50	**$1.00**
74HC373 (Octal 'D' latch)	Z-5965	$4.50	**$1.50**
74C157 (Quad 2 in mux)	Z-5374	$4.50	**$2.50**
74C221 (Dual mono multivib)	Z-5378	$3.50	**$2.00**
74C946 (4.5 dig counter)	Z-6301	$24.50	**$10.50**
Low Power Schottky...			
74LS00 (Quad 2 in NAND)	Z-4900	75¢	**40¢**
74LS14 (Hex Schmitt)	Z-4914	75¢	**30¢**
74LS138 (1 of 8 dec/mux)	Z-5284	75¢	**40¢**
74LS241 (Oct buff/driv)	Z-5293	$2.50	**$1.00**
And TTL, too!			
7400 (quad 2 in NAND)	Z-5010	50¢	**30¢**
7401 (Q NAND, O/Coll)	Z-5011	50¢	**25¢**
7413 (Dual schmitt)	Z-5023	95¢	**40¢**
And other semi savings:			
LM3909 (Monostable Osc)	Z-6109	$2.25	**$1.00**
Get an optic on these optics:			
LT312 (Comm An 7 seg dis)	Z-4117	$2.25	**$1.00**
3mm Orange LEDs	Z-4031	15¢	**5¢**
3mm Red LEDs	Z-4010	15¢	**5¢**
3mm Green LEDs (premium qual)	Z-4079	35¢	**15¢**
Rectang. Red LEDs (2 x 5mm)	Z-4040	25¢	**10¢**
And even transistors...			
DS548 (yes, equiv to BC108)	Z-1308	19¢	**10¢**
DS558 (equiv to BC558 etc)	Z-1348	19¢	**10¢**
BC549C (top spec, hi gain)	Z-1329	40¢	**10¢**
MRF629 (RF silicon NPN)	Z-2509	$16.45	**$5.00**
MJE2955 (PNP Power silicon)	Z-2005	$2.25	**50¢**
FETs, too:			
MPF131 (N-channel g/p)	Z-1848	$1.80	**$1.00**
2SK134 (hi power mosfet)	Z-1815	$8.95	**$4.95**

MEASURE THE SAVINGS WITH THESE BEAUTIES...

Ultra Compact 3.5 Digit Meter

Small in size, big on features! Auto ranging for voltage and resistance and 2 current ranges: 20mA or 10A. Low power ohms limits open circuit voltage (suitable for in-circuit resistance measurement). **DC Voltage:** 200mV, 2, 20, 200, 1000V +/-(0.5% +1dgt). **AC Voltage:** 2V, 20, 200, 750V +/-(0.75% +5dgt). **Resistance:** 2 ranges: 200 ohm - 2M FSD.
Cat Q-1515

$99

Economy Meter

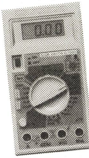
For the price, you'll be amazed at the performance! 3.5 digit wide angled display for easy viewing. RF shielding and resistance range overload protection: handles 250V AC or 350V DC indefinitely. **DC Voltage:** 2000mV, 20, 200. 1000V +/-(0.5%rdg +/-2d). **AC Voltage:** 200V, 750V +/-(1.2%rdg +/-10d). **Resistance:** 2000, 20, 200, 2000 ohms +/-(0.75%rdg +/-1.2%rdg).
Cat Q-1520

$64.95

SAVE! Build it yourself and save $$$... enjoy the latest and the best with DSE kits.

LCD Meter Cap/ Transistor Checker

— a 3-in-1 bargain for every bench and tool box. It's a 33 range multimeter with auto zero and over-range indication, exceptional high current measurement (10AC/DC) and much more. But that's not all! Check capacitance in five ranges from 2nF - 20uF... plus transistors (hFE 0-1000) and diodes (Vf) too. Sensational value that saves the cost of buying other instruments. Cat Q-1500



GREAT VALUE!

$139

LCD Temperature/ Meter

What a combination! 3.5 LCD multimeter for current and voltage checking with over-ride indicator, buzzer continuity and 0.1%/0.25% accuracy. Also takes thermal readings (F and C) for scientific and hobbyist measurements: check heatsinks, etc. Covers -20 to 1370° C with +/-0.3% +/-1° C accuracy. Cat Q-1512

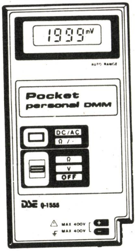
Measure the temperature of power transistors, heatsinks, etc.

NEW

BARGAIN AT ONLY

$199

Complete with probes

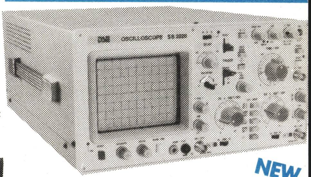


The Personal Pocket Meter

Calculator sized meter adds up to convenience: only 10mm thick! Boasts • super fast auto ranging • auto polarity indicator with minus sign • 2x/second sampling • audible continuity (200 ohm +/- 10 ohm). Excellent frequency response allows it to be used as a millivolt meter — up to 20KHz. **DC Voltage:** 2000mV, 20, 200, 400V +/-(2.0%rdg +/-2dgt). **AC Voltage:** 200mV, 20, 200, 400V +/-3.0%rdg +/-5dgt). **Resistance:** 200 to 2Mohm in 5 auto ranges.
Cat Q-1555

VALUE! **$59.95**

Unbeatable value for dual trace 20MHz CRO!



NEW

- 1mV Sensitivity
- + and - Algebraic additions

Sensational value! An affordable, professional standard 20MHz oscilloscope that's got the lot: **Bandwidth:** DC to 20MHz (-3dB). **Input impedance:** 1m ohm to 25pF +-2%. **Algebraic addition:** CHI+CHII, -CHI+CHII. **Sweep time:** 0.1us/DIV - 0.2s/DIV +/-3% (10°C -.35°C) steps in 1-2-5 sequence. **Expansion:** x10 MAG sweep rate up to 50ns, additional error for magnifier +/-2%. Cat Q-1260

ONLY **$949**

Equipping your service bench, lab or school...
SAVE! Two for $899 each.

Troubleshooting from the hip (pocket)...

Neat! Handy pocket-sized signal injector with simple push button operation... Perfect for servicemen on the go. **Frequency range:** 700 - 1000Hz with harmonics to 30MHz. **Signal output:** 1.4V p-p. Impedance:10K ohm (capacitive). **DC voltage input:** 50V max. Suitable for in-circuit (live) testing where voltage range is -3 to +50VDC. Cat Q-1270

VALUE AT ONLY! **$7.95** WAS $12.25

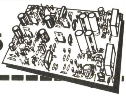
Improve Amp performance...

SAVE $10

Your amp straining to live up to expectations? Our Ultra Fidelity Preamp gives a boost to dynamic range and frequency response, reduces noise and distortion. **Max. output:** > 2V rms. **Freq. response:** conforms to RIAA within +/-0.2dB typical with 1% components. **THD:** <0.001%/100mV, 100Hz-10Hz (MM cartridge); <0.004%/100mV, 100Hz-10kHz (MC cartridge). As described in AEM
Cat K-3037

ONLY!

$39.95



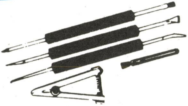
Double enjoyment: Stereo Simulator II

Get more from your old mono TV, video or AM tuner with our Stereo Simulator II. Produces artificial channel separation so good, it's hard to distinguish it from the real thing! **Signal-to-noise ratio:** 60dB (left), 56dB (right). **Distortion:** 0.1% (both channels). **Current drain:** 6.5mA without LED, 17mA with LED.
EA APRIL '83 Cat K-3421

BARGAIN

$26.95

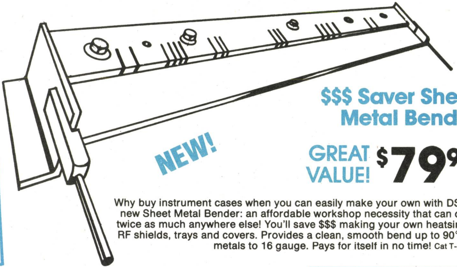
$TOCKTAKE $UPER $AVERS...



Soldering Aid Set

Inexpensive kit that's a 'must' for PCB soldering work. Includes everything you need for a professional job: guide fork tool, reamer point and knife tool, scriber, heatsink clip and stainless steel bristle brush. Great for restringing dials too! Cat T-2610

BARGAIN AT ONLY $17.55



NEW!

$$$ Saver Sheet Metal Bender

GREAT VALUE! $79.95

Why buy instrument cases when you can easily make your own with DSE's new Sheet Metal Bender: an affordable workshop necessity that can cost twice as much anywhere else! You'll save $$$ making your own heatsinks, RF shields, trays and covers. Provides a clean, smooth bend up to 90° on metals to 16 gauge. Pays for itself in no time! Cat T-5250

Premium Solder

ighest quality, non-corrosive solder for lectrical work. 60% tin, 40% lead compound.
hoice of two:
.25mm, 200g. Cat N-1619
.75mm, 200g. Cat N-1623

8.25 each

Soldering Aluminium?

ur ALU-SOL solder is ideal... perfect for any issimilar metal. 1.6mm, 100g roll. Cat N-1625

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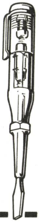

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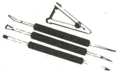

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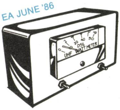

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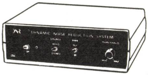

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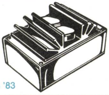

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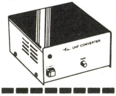

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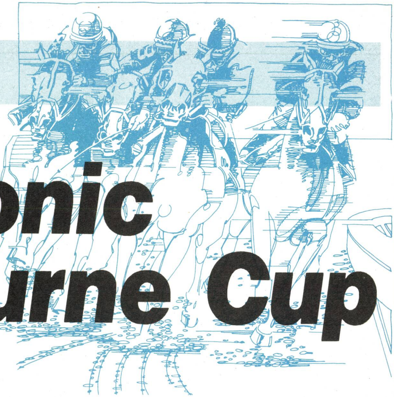
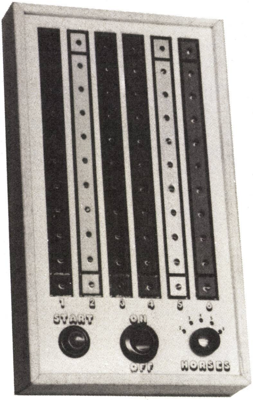


Electronic Melbourne Cup

by W. SCHOPP

This electronic horse-racing game has all the fun, excitement and unpredictability of the real thing. It's easy to assemble and the parts are all readily available.



The six lanes represent the six horses.

"And they're racing! . . ." in the Electronic Melbourne Cup. Here's the electronic version of the Sport of Kings. The thrills of the race and the uncertainty of the winner can be yours without those temperamental equines.

Actually, this project first appeared in the US magazine *Hands-on Electronics* under the name "Electronics Kentucky Derby". Aha!, we thought, just the thing for sports-minded Aussies. We've Aussiefied the name to "Electronic Melbourne Cup", but that's about all.

This is a horse race with no ring-ins, no hay and no horsing around — just a random winner. There are six horses represented by six rows of eleven light emitting diodes (LEDs): 10 green and one red. The position of each horse is indicated by a glowing green LED, while the red LEDs are wired in parallel with a green LED at the end of each row so that the winner stands out from the losers.

When the start button is depressed, all the horses line up at the starting gate, with the first LED in each row glowing. Once the start button is released, the horses start moving towards the finish line. Each second, a randomly selected horse jumps one step. The first horse to finish the line (the tenth LED in the row) freezes the action and the race is over.

The next race begins when the start button is pushed and released again. Switch S1 (Horses), allows any number of horses from two to six to be selected. Horses not in the race are left at the post to avoid confusion.

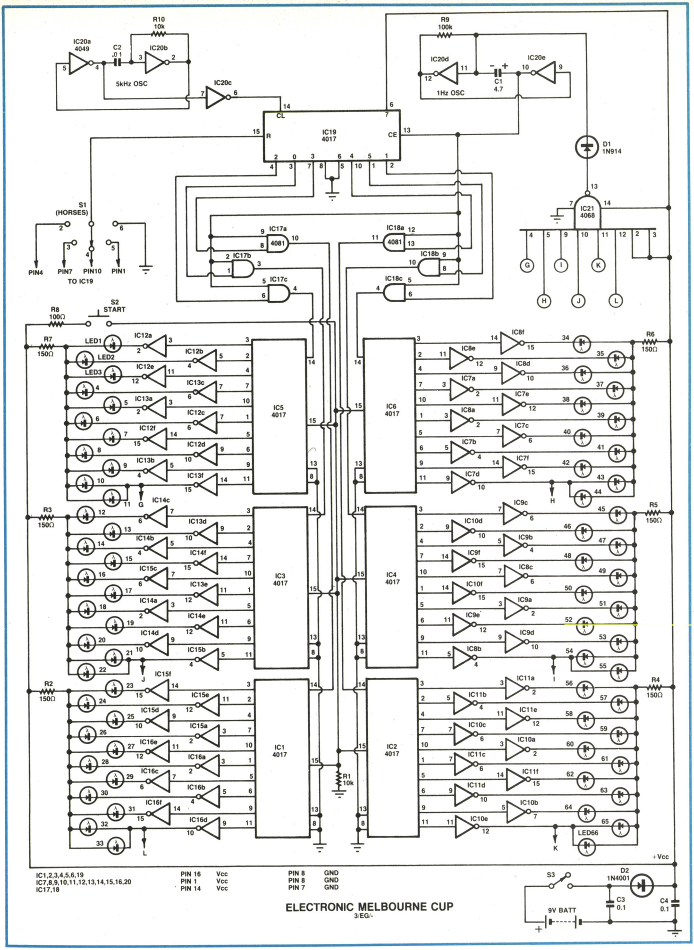
The circuit itself is based on inexpensive CMOS ICs, and can be battery-powered using four "C" cells in series. Alternatively, a 6-9V plugpack adaptor can be used.

Circuit description

Refer now to the circuit diagram. Hex-inverting buffer IC20 is used to make up two separate oscillator circuits. The first, comprising IC20a and IC20b, provides a 5kHz signal that's fed through buffer IC20c to the clock (pin 14) of IC19, a 4017 CMOS decade counter.

The second oscillator, made up of IC20d and IC20e, feeds a 1Hz signal to IC19's enable (pin 13). Thus, every second, 5,000 pulses (give or take a few) are fed into IC19; after that, the gating is inhibited. That leaves IC19 with a signal on one of its active outputs, depending on just when the counter was gated off.

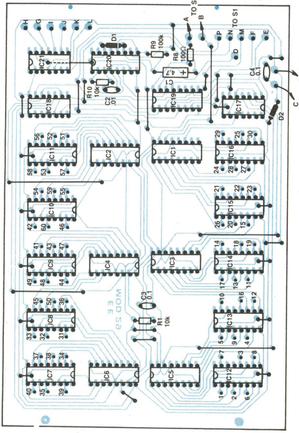
Component mismatch and thermal drift variations assure that the precise number of pulses between gating signals

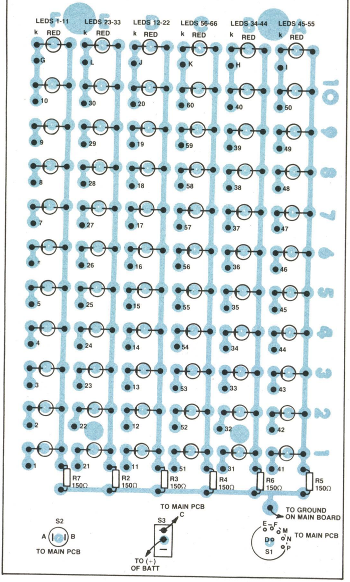


IC1,2,3,4,5,6,19	PIN 16 Vcc	PIN 8 GND
IC7,8,9,10,11,12,13,14,15,16,20	PIN 1 Vcc	PIN 8 GND
IC17,18	PIN 14 Vcc	PIN 7 GND

ELECTRONIC MELBOURNE CUP

3/EG/-





The main circuit board contains the bulk of the electronics for the Electronic Melbourne Cup. The pads labelled 1-60 and A-P connect to corresponding pads on the front panel board.
Right: the LEDs, resistors and switches are all mounted on the copper side of the display board (see text).

will be different each time. Each pulse represents a different output at counter IC19.

The gating signal that's fed to IC19 at pin 13 is also used as an enable signal for the individual gates of IC17 and IC18. One input of each gate is tied to the enable pin of IC19 and the other is tied to one of the outputs of IC19. Depending on the logic appearing at the outputs of IC19, one of the gates is turned on.

During each second that the gate is turned on, a signal is fed to one of six 4017 decade counters, IC1 to IC6, which sequentially advance one count for each positive transition of the received input signal. The counter outputs are fed to the light-emitting diode indicators through the individual buffers of IC7 to IC16 (4049 hex inverters) which provide increased drive current for the LEDs. Thus, as the count advances, one LED of a particular lane extinguishes, and another lights.

When the winning horse crosses the finish line (indicated by the tenth and eleventh LEDs in the lane being lit), a low signal is fed to one of the active inputs of IC21 (a 4068 CMOS Dual 8-input NAND). This produces a high output from IC21, which is fed to the gating oscillator via diode D1. This, in turn, stops the oscillator and all further action, eliminating photo finishes

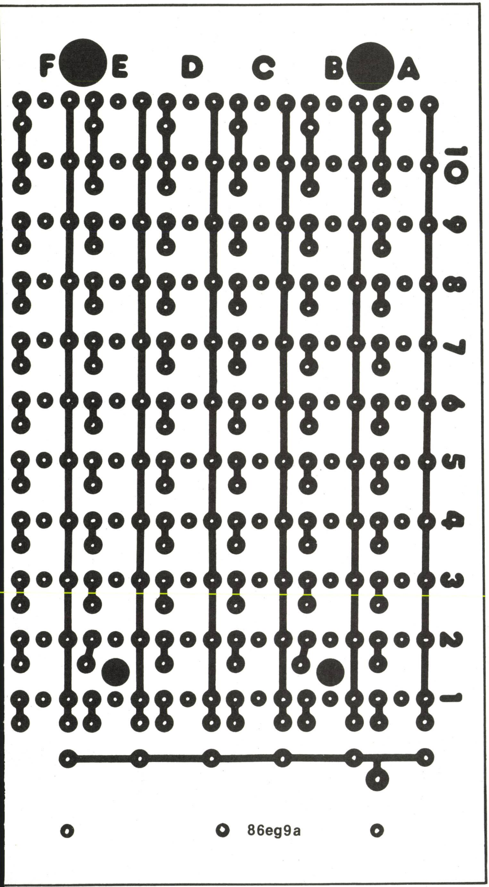
Switch S1 selects the appropriate output signal from IC19 and feeds it back into the reset (pin 15) of the same IC. This stops those horses not racing from receiving count pulses and allows operation of from two to six horses to accommodate various numbers of players.

When only two horses are running, the B and D lanes are used. When the third horse is added, it operates in the F lane. The fourth horse activates the E lane and the fifth horse uses the C lane. If the horses are numbered on the front panel, use the sequence 6, 1, 5, 2, 4, and 3 from left to right (yes, the prototype shows otherwise). In that way, the horses are dropped from the race in numerical order by the selector switch, S1.

Pushbutton switch S2 is the reset switch. When pressed, it pulls the reset inputs (pin 15) on counters IC1 to IC6 high. This resets the counters so that the 'horses' return to the starting gate.

Construction

The Electronic Melbourne Cup consists of two single-sided PC boards. One of them doubles as the front panel and carries the LED indicators and the controls. It is coded 86eg9b and measures 167 x 112mm.



Above: actual size PC artwork for the front panel of the Electronic Melbourne Cup.

PARTS LIST

1 PCB, code 86eg9a, 134 x 234mm
1 PCB, code 86eg9b 167 x 112mm
4 1.5V size-C batteries (see text)
1 4-way size-C battery holder
1 jack socket (see text)
4 6mm brass spacers
1 case to suit (see text

Switches

S1 — single pole 5-position rotary switch
S2 — SPST momentary contact pushbutton switch
S3 — SPST rocker or toggle switch

Semiconductors

60 green LEDs
6 red LEDs
D1 — 1N4148 diode
D2 — 1N4001 diode
IC1-IC6, IC19 — 4017 CMOS decade counters
IC7-IC16, IC20 — 4049 CMOS hex inverters
IC17, IC18 — 4081 quad AND gate
IC21 — 4068 8-input NAND gate

Capacitors

C1 — 4.7μF 25VW electrolytic
C2 — .01μF ceramic
C3, C4 — 0.1μF ceramic

Resistors (0.25W, 5%)

R1, R10 — 10kΩ
R2-R7 — 150Ω
R8 – 100Ω
R9 – 100kΩ

On the front panel board, it will be necessary to drill 3mm holes (see Fig. 4) where the LEDs are to be mounted. At the positions labelled S1, S2 and S3, drill holes large enough to accommodate the control switches.

Next, handpaint the lanes using six bright colours. Once dry, dry-transfer lettering may be used to label the lanes and control switches. After that, spray the front panel with a hard-setting clear lacquer to protect the finish.

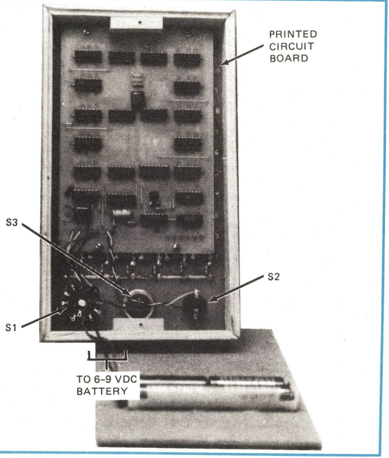
When the lacquer is dry, the LEDs can be pushed through the holes in the front panel from the rear and their leads soldered to the pads on either side of the holes. The long lead of the LED is the anode and is connected to the PCB bus marked +V. Sixty green light emitting diodes are mounted in lanes A-F, positions 1-10. The top six positions are reserved for the red winner indicator LEDs.

The common dropping resistors (R2-R7) are connected by tack-soldering them to the copper side of the board (ie, the resistors are mounted on the copper side of the PCB). Construction of the front panel assembly can now be completed by soldering four 6mm-long threaded brass standoffs to the large pads provided. These should be located to line up with the mounting holes in the main PCB.

Refer now to the parts layout diagram for the main PCB. Note that there are many wire links, some of which pass under ICs. Install these first, then the resistors and capacitors, making sure that C1, the only electrolytic in the circuit, is correctly oriented.

Now install the semiconductors, paying close attention to their orientation. This done, lay the two boards end-to-end with their copper sides up and complete the wiring between them using insulated hookup wire. This simply involves connecting the designated wiring points on the display PCB to the corresponding points on the main PCB.

Be very careful with the wiring, as a mistake at this point can result in a horse that occasionally runs backwards! Note that these wiring connections



The two printed circuit boards are mounted back-to-back, hiding the unsightly rats-nest of interconnecting wires.

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- Interrupt Handling
- Foreground/Background Operation

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- 2 Multiplying Analog Output Channels
- 8 Bit Digital I/O
- Interrupt Handling
- Foreground/Background Operation

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- On-Board Signal Conditioning
- Direct Temperature measurement (-200 to +650 C)
- 12 Bits of Digital I/O
- Interrupt Handling
- 2 Optional 12 Bit Analog Output Channels
- 2 Optional Instrumentation Amplifiers (0.5 MicroVolt/Bit)
- Foreground/Background Operation

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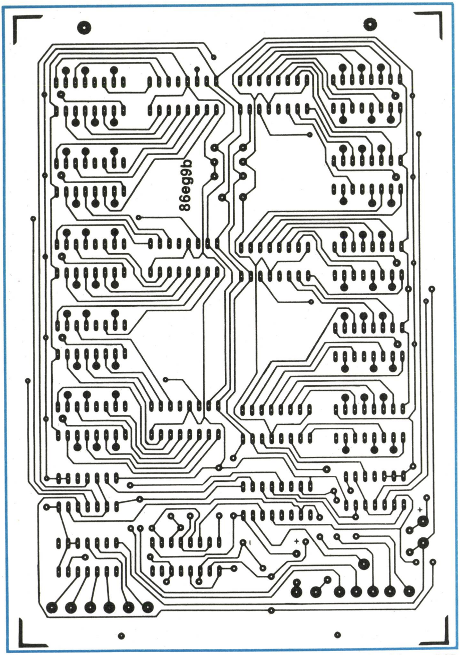

Above: the main PCB can be etched from this actual-size pattern or ordered from a PCB manufacturer (see advertisements in Marketplace, page 130).

should all be made directly to the back of the two PCBs.

With the interboard wiring now completed, solder short leads to the pads that connect to S1 and S2. Also, solder leads to the positive (+) and negative (−) pads on the main board and to the V+ bus on the back of the front panel. This done, the two boards may be folded together and the main board bolted to the standoffs.

The completed game is too big for a standard zippy case. Instead, we suggest that it be built into a wooden box, complete with batteries. Some readers may wish to use a plugpack power supply. In this case, mount a small jack socket on the case and wire it to the supply pads on the main board.

When your horse race game is complete, no handicapping is necessary because any horse can win by random choice. One race, your horse may never get out of the starting gate and the next race, the same horse could win by ten lengths. All you need to pick a winner is a lot of luck!

Come to think about it, that's the way it is at the track too! EA

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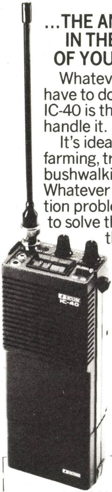


The Serviceman

Two heads are better than one, even if . . .

As any practising serviceman will confirm, practical, in-the-field servicing depends on a lot more than technical skill and experience. Luck — both good and bad — and sheer coincidence, often play a major role in tracking down an elusive fault. And even bad luck can sometimes turn out to be good luck in the end.

This story really started with someone else's problem. As I have mentioned in these notes before I have a colleague in business in a nearby suburb and who, in theory at least, should be a business rival. In fact, we are very good mates. We frequently exchange experiences, borrow manuals, and generally work together in close harmony. It is a pleasant arrangement which has saved both ourselves and our customers a lot of time and money over the years.

I was driving past his shop one morning, on my way to a customer's home, when he spotted me from the footpath and waved me into the kerb. And, while I was in a hurry, I reasoned it must be something important. But just how important I doubt whether either of us realised at the time.

After the usual pleasantries he came quickly to the point. "I'll bet you've never seen a fault like the one I've got in the workshop at the moment. It's a real weird one; come and have a look at it." I was a bit sceptical about his claim; I reckoned I'd seen everything, at least as far as symptoms are concerned. But I said nothing and followed him into the workshop.

The set in question was a National portable of around 34cm, but I didn't take particular note of the model number. Of far more interest was the image it was portraying. It was a normally locked picture but the lower portion of the screen was blacked out. The height varied from about half to a third and, to further complicate matters, the effect didn't extend over the full width. It started about 50mm in from the right hand side and the edge was curved, rather like the first 90° of a sine wave.

Well, I had to admit that my friend was right; I had never seen anything remotely resembling it before. And having admitted that, my natural query was what ideas he had about it, or what progress he had made. Not much, as it transpired. He had originally been called to the customer's home, the fault having been fairly accurately described over the phone. But, by the time he made the call the fault had vanished. So it was intermittent as well.

A few days later the customer delivered the set to the shop, saying that the fault had returned. Sure enough, a quick check confirmed this and demonstrated the exact nature of it to my colleague for the first time. Realising that it was likely to be a curly one he suggested to the customer that it might take some time. The customer wasn't particularly worried about this, as it was only a second set. So my colleague put it aside for a week or so while he attended to a backlog of more routine repairs.

Then, with some time to spare, he set it up on the bench and turned it on. Need I say more? Murphy was in full control. Not only did the set play perfectly, but it kept on playing all day and every day for over a week. Finally, he decided to advise the customer that he had better take it home again and bring it back if and when the fault returned. At least, that was the intention. No sooner had he said as much on the phone when he glanced up and realised that the fault had returned. So it was a case of "as you were".

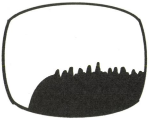
As to progress, this had been confined to observing the colour bar generator staircase pattern where it entered the main video chip, and again where it came out. It was normal at the input, but had ". . . a funny kind of retrace line added to it at the output". From this he had concluded that the chip was at fault, and was waiting on a replacement. So that was that and, being in a hurry, I wished him luck — somewhat tongue-in-cheek — and hurried back to the van. I was glad it was his problem and not mine.

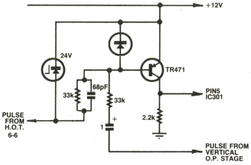
A problem shared

The next day one of my first calls was to a new customer to try to make sense of an on-again, off-again situation. He had originally called me about a week previously saying that he had a faulty TV set, but without being able to describe the fault in any worthwhile way. Then, a couple of days later he had rung to cancel the appointment, saying the set had come good. Then a day or so later came another phone call saying the fault was back.

So here I was, face to face with what promised to be another cranky intermittent. I wouldn't have been at all surprised if the fault had refused to appear but this time Murphy was asleep and the fault came up immediately. And would you believe it; it was exactly the same fault as I had seen in my colleague's workshop the day before. I didn't know whether to laugh or cry, so finished doing neither.

Needless to say, the set was a National. More specifically, it was a model TC-2003 48cm and, as I suspected and





The relevant portion of the National TC-2003 circuit, where the fault was finally located. It delivers blanking pulses to IC301.

later confirmed, used essentially the same circuit as the smaller version on my colleague's bench. As my colleague had done, I explained to the customer that I would have to take the set back to the shop and that it might take some time.

Back at the shop the first thing I did was to ring my colleague and enquire whether he had made any progress. He hadn't, but was agreeably surprised at my concern for his problem — until I confessed that I had exactly the same problem on my bench. And so we agreed to keep in touch; the first one to discover anything significant would contact the other. After all, two heads should be better than one.

Fortunately I have a manual for this set, although I have not had a great deal of experience with it. Acting on my colleague's experience, my first check point was the video chip, IC301, AN-245. I fed a colour bar pattern into the set and checked this at the input, pin 14. It appeared to be perfect. Then I checked the output, pin 6. Here I found what I imagined was the effect my colleague had found; a normal staircase pattern but with a curved flyback line from the top of the staircase back to the blanking period at the foot of the staircase. I had no idea what it meant, but I was quite sure it shouldn't be there.

I made a voltage check on the appropriate chip pins but found, as had my colleague, that they were all within a whisker of specifications. So it looked like the chip. And since I didn't have one either, I put one on order. This arrived in due course and I set to work with the solder sucker, removed the existing chip, and fitted a socket in its place. Then I plugged in the new chip and switched on expectantly.

No prizes for guessing, of course. The fault was there exactly as before. I swapped the two chips around, just to make sure, but they both behaved identically. I rang my colleague and found that he was on the point of ringing me to report exactly the same situation. So we were both back to square one.

I went back to the manual and had a long hard look at the circuitry around the video chip. One thing was fairly obvious. If the signal coming in was correct, and that coming out was not, and the chip was OK, then it had to be something the chip was seeing from outside; a wrong static voltage, a wrong signal, or a faulty component.

The block diagram of the chip indicated that it provides video amplification, contrast control, sync separation, pedestal clamp, and noise cancelling. As already mentioned, the video signal comes in on pin 14 and out on pin 6, but there is more to it than that. From pin 14 it goes through the contrast control network, comes out on pin 12, goes to a "picture control" (contrast) pot, comes in again on pin 10, out on pin 9, in on pin 8 to the video amp network, then finally out on pin 6.

Naturally, all these ins and outs provide scope for the video signal to be both upset and to be checked. I spent some time working around the chip and familiarising myself with the various functions and making as many checks as I could think of. I even went so far as to change several electrolytic capacitors, C306, C307 and C309.

This did nothing to cure the fault, but I was becoming increasingly convinced that the fault was something to do with the pedestal clamp or blanking pulse circuitry. In particular, there was a 13V rectangular blanking pulse fed into pin 5 and thence into the internal video amp.

A check with the CRO showed that this pulse was fairly close to the shape shown, though not exactly so and, in any case, the information given, apart from the amplitude, was limited. So there wasn't much to go on, but I was feeling rather desperate so I decided to trace it back to its origin. I don't know what I expected to find but I was ready to try anything.

Tracing this path through the circuit wasn't easy, but I eventually tracked it down to a transistor, TR471, on another board; the "E" board carrying most of the deflection circuitry. TR471 is an NPN type (2SA564A) described as a pulse amplifier. It is fed with a pulse from an auxiliary winding on the line output transformer (terminal 6-6) which also drives some of the deflection circuitry. The stage is obviously as much a pulse shaper as an amplifier.

Wrong waveform

The circuit shows the waveform of the signal at the base of TR471, best described as a rectangular shape with spikes on it, and with a 2.5Vp-p amplitude (waveform No.32). A check with the CRO revealed a waveform of about the right amplitude but far removed from the shape shown. Naturally, I felt that this was significant, even though I wasn't really sure why. But that was not the only suspicious factor. As I mentioned at the beginning, the blacked out portion of the screen on my colleague's set varied randomly from about one third to one half the height of the screen.

I had observed the same characteristics on this set and, as I monitored the waveform, I realised that, while its amplitude seemed to remain constant, its shape changed in sympathy with the changes on the screen. By now I was sure I was on the right track.

So, if this was the faulty stage, exactly what was wrong? There weren't that many components involved and I was quite prepared to change all of them if necessary. The most likely suspect was TR471 and this was easily changed, but made no difference. The rest of the circuit consists of a diode, D471, between emitter and base; a 2.2kΩ resistor, R474, between collector and chassis; a 33kΩ resistor, R472, and a 1μF capacitor, C471, in series, feeding a pulse from the vertical output stage to the base; and a small network between emitter and base.

This network consists of a 24V zener diode, D858, connected to the emitter on one side, and to the base on the other side via a 33kΩ resistor, R471, and a parallel 68pF capacitor, C472. The junction of the zener and the R/C network is the input point for the horizontal pulses from terminal 6-6.

One by one I changed or checked each one of these — with one exception — and drew a blank in every case; the fault remained stubbornly in evidence. The exception was the 24V zener diode, which I was unable to change for the simple reason that I had no such value in stock. But when all the other tests failed I went through my stock in the hope that I could make up the value from what I did have.

Again I was out of luck. The best I could muster was 15V and 6.8V, making 21.8V. I had no idea how critical the zener value was but I reasoned that, if the existing one had a "funny" in it, the replacement should provide at least some kind of a clue. So this combination was duly fitted.

The smoke test

Then, not knowing quite what to expect, I switched on. Imagine my surprise when the set warmed up and produced a perfect picture. But I didn't turn too many cartwheels immediately. The fault had shown some tendency to be intermittent or, at least, a tendency to vary with running time. So I let it run for the rest of the day and it didn't miss a beat. And after it had run for a couple more hours the following day I felt pretty confident that the zener was to blame.

Strangely enough, by all the checks I could make on it, I could find nothing wrong with it; it was turning over at the right voltage and I could not detect any leakage. But then, we all know that solid state devices can develop strange characteristics which are very hard to measure.

But I was still curious as to how critical was this zener voltage. Going through my stock again I fished out a pair of 13V units and put them together to make a 26V version. With these in place I tried again, only to discover that the fault was back and moreover, was worse than ever, something like three quarters of the screen now being blacked out.

So, did I really have a faulty 24V zener, or had this value suddenly become unduly critical for some reason? I decided to ring my colleague, both to find out what progress he had made, and to let him know what I had found.

It transpired that he had followed virtually the same path as I had; from the video chip down to TR471, noted the ramifications of the waveform, and concluded that this stage was a likely suspect. And, like myself, he had changed or checked all the components in the stage. The only difference was that he had achieved nothing.

"What about the zener diode?" I asked.

"Yes, I changed that."

"What did you use?"

"Another 24V zener, same as is in there."

I related my experience, and suggested he make up something like 22V and try that. With fresh hope he hurried off to do so.

A few minutes later he rang back. Yes, that had fixed it. But, like me, he could offer no explanation as to why. All we could be sure of was that there was almost certainly no fault in the original zeners. Whatever the reason, both sets now needed a zener a couple of volts lower than originally specified.

But why, and what had changed to bring this about? And why had both sets chosen to develop the same fault at almost exactly the same time? Quite frankly, we don't know. And having deprived the owners of their sets for long enough — and spent more time on the jobs than we could charge for — we let both sets run for a few more days and then returned them to their owners. That was many weeks ago and, at the time of writing, both sets are behaving perfectly.

(Incidentally, waveform No. 32, while it had changed significantly from its original shape, was still a long way from that portrayed on the circuit.)

She'll have to be right

And, while I would be the first to admit that the situation leaves a lot to be desired, the truth is that there is a limit to what a serviceman in the field — as distinct from an engineer in a laboratory — can do within the practical constraints of time and money. The best that one can hope for in cases like this is that time and experience — either yours or someone else's — will eventually provide the real answer. Until then we keep our fingers crossed.

But that aside, I think readers will appreciate what I said at the beginning about luck and coincidence. Had my colleague been the only one of us to encounter the problem, he may well have looked for it in vain. And I might well have been in the same situation had it not been for the bad(?) luck of not having a 24V zener in stock.

Anyway, if there are any readers out there who know the answer, or find it following our leads, my colleague, myself, and our readers would very much like to hear about it.

And now for some readers' comments.

From Mr D.A., of Findon, S.A. comes a comment about the letter from Mr D.P., in the June issue, about problems with a TV set operating from a home lighting plant. He writes as follows:

After wire sizes were changed from imperial to metric, the size has often been given as its cross sectional area, rather than its diameter. This appears to be common with 240V cables.

Could it be possible that the 10mm wire used by the gentleman with TV problems (June 86) was actually 10mm^2.

If this was the case he would be using a wire that was only 1.78mm diameter (0.072in) or between 15 and 16SWG, and he would certainly have voltage drop problems.

Thank you D.A. for a most interesting suggestion. Without casting any doubts on your statement I must confess that I have never encountered this convention, the wisdom of which I seriously question. Most people — even those of us who welcomed the metric system — had enough trouble handling the conversion, without red herrings of this

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kind to compound the issue.

At the same time I am aware that the automotive industry has its own funny way of designating wire sizes. While using metric measurements they specify the overall diameter of the cable, including the insulation, which is the major thickness. Thus a 3mm automotive cable has an actual conductor size of about 1mm and 2mm of insulation.

But to get back to D.P.'s original problem. Unfortunately, I have no way of confirming whether D.A.'s suggestion — or my own in the June issue — is likely to be correct. I imagine D.P. is the only one who could clarify the situation, and I have heard nothing further from him.

Anyway, thanks again D.A. for taking the trouble to write. Even if this is not the answer, your comments have at least drawn attention to a potential source of confusion in regard to wire sizes. I'll be on the lookout for that one.

The next letter is from Mr J.R. of Petersham, NSW. He writes:

I recently bought a Dick Smith power point checker and, while checking a friend's house, came across the enclosed double adaptor. It showed up as active/neutral reversed (on one side) and when you have a close look you can see why.

I would guess these are no longer on the market, but may be used in a reader's home.

No doubt they are illegal and you may care to publish a short note as a warning.

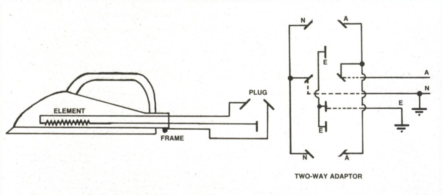
The double adaptor enclosed is an Australian make "Elmaco", which I have not seen before, but it is in a format which was once quite popular. Rumaging through one of my "surplus components" (junk) boxes, I came up with a similar device made by "Clipsal" and, as I recall, they were available in other popular brands.

As J.R. suggests, they are no longer an approved device and were taken off the market several years ago. In greater detail, they transferred the active/neutral pins of the power point to the same position on one outlet, but transposed them on the other outlet. The reason was simple; it was easier to make them that way, and would have been much more difficult to make them the other, preferred, way.

Initially, this transposition was not regarded very seriously, mainly on the basis that it didn't really matter as long as every other component in the system was correctly wired. At least, that was the rationale at the time. In fact, experience was to show that this assumption (that everything else would be correct) was dangerously false. In particular, wrongly wired appliances which would work — albeit by default — in a proper power point could become lethal devices when plugged into one of these adaptors.

The magic toaster

Nor is the situation a new one. Mr J.R.'s letter reminded me of a particularly dangerous situation which I described in these notes some 35 years ago, April 1951 to be exact. (The staff member who finally pinpointed the article for me was kind enough to point out that he was only one month old when the story appeared. Never mind, he'll be old himself one day!)



Mixing up the earth and one active lead of the appliance gave very puzzling and dangerous effects when used with a 3-pin double adaptor. Work out the connections for yourself.

Anyway, the story went something like this. After a rather involved service job the lady of the house made me a pot of tea, then plugged in the toaster to prepare something to go with it, but the toaster refused to heat. And this is how I told it then.

"Oh, of course," exlaimed the housewife with an air of exasperation, "it's plugged into the wrong side of the adaptor." Whereupon she pulled it out of one side of the two-way adaptor, plugged it in the other side, and the element glowed merrily.

"Is one side of the adaptor faulty?" I asked, wondering, if it was, why they used the thing at all.

"Oh, no, I don't think so," she replied, and then prattled on gaily by way of explanation, "but you see the toaster has to be plugged into the top socket or it won't work, and the iron is the same, only it has to be in the bottom socket, and it won't work when it is in the socket on the wall, but only when it is in the adaptor. It certainly is annoying when you put them in the wrong one."

I won't pretend that I was able to follow the technical reasoning behind all this, at the pace it was delivered, but I was quite sure that something very serious was wrong.

"It might be a good idea if I had a look at the toaster," I said, "and the iron, too. I'm afraid they might be dangerous." This announcement was received with a partial air of disbelief, but she hurried off to get the iron. An examination of the toaster cord confirmed what I had now begun to suspect, namely, that the connections to the plug were incorrect. One lead from the element was connected to the earth pin of the plug, while the frame of the toaster was connected to one of the active pins!

When the toaster was plugged into the top socket it so happened that the frame was connected to the neutral side of the line, while the element was between the active side and earth. This allowed the toaster to function and was reasonably safe, because the neutral side of the line is normally earthed.

However, when it was plugged into the bottom socket the position was quite different. Because of the way in which these adaptors are constructed, the connections to the mains are reversed, so the position now was: element between neutral and earth, and the frame to the active pin. This meant that no voltage was applied to the element, but that the frame was at 240 volts with respect to any convenient earth.

And when I say convenient earth, I have in mind that the normal working position for the toaster was only about two feet from the gas stove.

I rewired the plug, checked it with the ohmmeter and finally tried it in both sides of the adaptor. All was well, so I turned my attention to the iron.

Much the same conditions prevailed here, with the frame connected to one of the active pins. However, in this case, it was the opposite pin to that of the toaster, so that the iron would only work when in the bottom socket of the adaptor. It was inoperative, and dangerous, when in the top one, and also when plugged directly into the wall socket.

I learned, upon inquiry, that the usual position for the ironing board was between the gas stove and the sink, "Handy to the tap when you want water for damping down, you know," explained the housewife.

I shuddered.

Well, that's an abbreviated version of my double adaptor story from way back, J.R., and I think you'll agree that I had good reason to shudder. In short, the problem has been around for a long while and, as you suggest, there are undoubtedly a lot of these devices still in use by unsuspecting householders. The best idea would be to get rid of them but, if they must be used, at least make sure that all associated appliances are correctly wired.

Which isn't a bad idea anyway, double adaptors or not.

TETIA Fault of the Month

Hitachi CEP288
(PAL 3A chassis)

Symptom: No go. Line drive near normal and correct voltage at TR59 collector.

Cure: Open circuit emitter return to TR59. This can be a break in L780 or a dry joint at ZE3. If plug ZE is melted, look for hairline cracks in nearby tracks.

This information is supplied by courtesy of the Tasmanian branch of The Electronic Technicians' Institute of Australia. Contributions should be sent to J. Lawler, 16 Adina St, Geilston Bay, 7105.

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Forget about trailing cords. Build this

FM wireless transmitter

Forget about tangled microphone and guitar cords. This professional-quality FM wireless link will eliminate all those hassles. Expensive, you ask? How does $12.95 sound?

by BRANCO JUSTIC

One does not have to look far these days to observe the increasing trend towards the use of wireless microphones by professional entertainers and musicians.

The benefit of a wireless link for the "out front" entertainer is obvious, especially in club situations where they often step off the stage and mingle with the audience. In addition, many musicians are also using wireless microphones so that they are free to move around the stage rather than being attached to their amplifiers via connecting cables.

Microphone cables also have other problems. Whether through rough treatment or just through lack of cleaning, they often lead to unreliable operation. The more robust "professional" or "stage" chords are so expensive that a wireless link starts to look like a pretty good proposition.

Although there are lots of low-cost FM wireless microphones on the market, they are mainly limited to domestic situations. Invariably, they suffer from one or more performance deficiencies, including:

(1) excessive change of output frequency when the antenna is moved;

(2) excessive change of output frequency as the battery discharges;

(3) poor signal-to-noise ratio;

(4) microphone inserts which are unsuitable for live performance situations; and

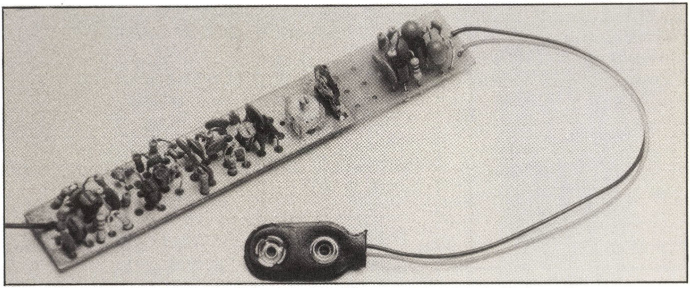
(5) optimal performance over only a small part of the FM broadcast band (usually around the middle of the band).

The FM transmitter described here overcomes all of these problems. It boasts excellent frequency stability, has a power output of about 10mW, and can be tuned across the entire FM broadcast band.

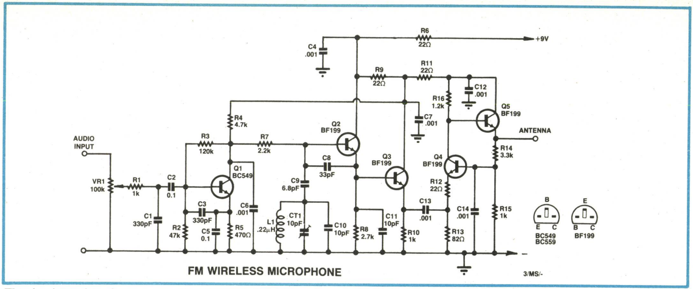
At the same time, it is very easy to build. There are no complex RF transformers to be wound; only one inductor is used in the circuit and this can be purchased prewound.

In its simplest form, the circuit is designed for use with high-impedance dynamic microphones. Alternatively, by adding a simple two-stage transistor amplifier, it can also be used with high-quality low-impedance microphones. Provision has been made on the PCB for this option.

As can be seen from the photograph, the PCB has been made quite narrow (19 x 120mm) so that it can be built into a piece of plastic conduit. The preamplifier section can be trimmed off if not required (see wiring diagram).



This prototype transmitter includes the optional microphone preamplifier. (Note: C10 not shown in this photograph.)



The circuit consists of common emitter stage Q1, Colpitts oscillator and output stage Q3, Q4 and Q5.

Circuit description

Refer now to the main circuit diagram. Input signals from the microphone are first applied to VR1 and then fed via a low pass filter to the base of common emitter stage Q1. VR1 allows the overall sensitivity to be tailored to suit different microphones or guitars. Its setting determines the maximum deviation of the FM signal.

R1, C1, C3 and C6 form the low pass filter stage. This ensures that the RF signal is eliminated from the input audio amplifier (Q1). C5 increases the gain at high audio frequencies to provide the necessary 50µs pre-emphasis.

Q2 and its associated components form a standard Colpitts oscillator with tuning provided by L1 and trimmer capacitor CT1. This stage derives its bias voltage from the output of the audio amplifier via R7. For this reason, the resistor values around Q1 were chosen carefully in order to produce minimal changes in oscillator frequency with changes in supply voltage.

The oscillator output appears at the emitter of Q2 and is direct-coupled to emitter-follower stage Q3. This stage provides buffering for the oscillator signal and a low impedance drive to the following output stage (Q4 and Q5).

Q4 and Q5 form a rather incestuous arrangement. Although they share common biasing components, they actually form two separate stages. Q4 functions as a common-base amplifier while Q5 is an emitter follower.

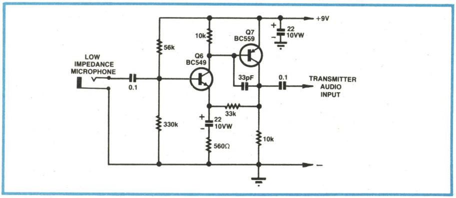


Fig.1: this preamplifier is used with low-impedance (600-ohm) microphones.

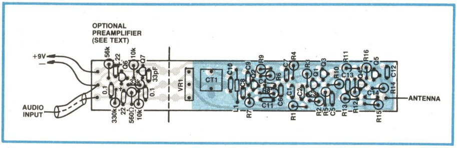
Preamplifier

Fig.1 shows the optional microphone preamplifier circuit. This is a fairly conventional two transistor circuit with an input impedance of around 30kΩ and an overall voltage gain of about 60.

Q6 and Q7 form a direct-coupled feedback arrangement with both transistors operating as common emitter amplifiers. Negative AC and DC feedback is applied from the collector of Q7 to the emitter of Q6 via a 33kΩ resistor. The ratio of this resistor to the 560Ω resistor sets the voltage gain of the circuit while the 22µF electrolytic capacitor in the emitter circuit of Q6 rolls off the low frequency response.

Specifications

Output Power	....10mW
Tuning Range	....80-110MHz
Frequency Response	..........20Hz to 15kHz
Frequency Stability	..............less than .025% drift
Range	.... 50 metres (approx.)



Above: parts layout for the PCB. Don't forget the five solder joints to the groundplane.

Construction

Construction is straightforward with all the parts mounted on a small PCB coded 86fm9 and measuring 120 x 19mm. Note that a ground plane is provided for the FM transmitter circuit, so the board is double-sided.

Note also that the parts are tightly packed on the PCB, with the resistors all mounted end-on in order to save space. Follow the layout diagram carefully when installing the parts on the PCB and mount the parts as close to

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the ground plane as possible.

There are five solder joints to be made on the component side of the PCB. These are indicated by unetched holes on the ground plane and are necessary to complete the earth circuit. The remaining leads all pass through etched holes and must not touch the ground plane.

Note that, on the prototype, the ground plane extends under trimpot VR1. This is not necessary and, in the final version, the ground plane is etched clear of VR1 as shown in the layout diagram.

Once all the parts have been installed, construction can be completed by connecting the antenna and the battery clip. A 50cm length of insulated hookup wire will make a satisfactory antenna. Connections to the microphone must be run using shielded audio cable.

The parts layout diagram shows how the circuit is wired when using the optional preamplifier stage. If you don't require the preamplifier, the signal input connections should be made directly to VR1. It's simply a matter of transferring the three supply/signal connections to the three corresponding pads adjacent to VR1.

Testing

Only two components require adjustment: CT1 which sets the transmitter frequency, and VR1 which sets the input signal level.

Initially, set VR1 to mid-range and place the transmitter near an FM receiver which is tuned to a vacant spot on the FM band. Now speak into the microphone and adjust the trimmer capacitor (CT1) until the transmitter is correctly tuned. Finally, adjust VR1 until the volume is similar to that which is obtained on the FM stations.

Note that good quality microphones have a huge dynamic range, so it is best to allow a reasonable amount of headroom; ie err on the low side in setting the level. If the input signal is excessive, the transmitter may be de-tuned.

We did not bother to mount the prototype in a piece of conduit but it would be quite impractical to leave it naked for long term use. Conduit with an internal diameter of about 23mm would make a suitable housing for the transmitter.

Although commercial units are usually potted into the housing, we wouldn't recommend this as being of any value. Perhaps a small amount of epoxy to seal each end of the tube would be OK — as long as you can still adjust the trimmer capacitor through a hole.

Next month, we plan to describe how to convert a commercial FM "Walkman" receiver for use with this transmitter. Together, the two form a very economical FM wireless link.

PARTS LIST

1 PCB, code 86fm9, 120 x 19mm
1 9V battery clip
L1 — 0.22μH air-cored inductor

Semiconductors

Q1 — BC549 NPN transistor
Q2, Q3, Q4, Q5 — BF199 NPN transistor

Capacitors

C1, C3 — 330pF ceramic
C2, C5 — 0.1μF ceramic
C4, C6, C7, C12, C13, C14 — .001μF ceramic
C8 — 33pF ceramic
C9 — 6.8pF ceramic
C10, C11 — 10pF ceramic
CT1 — 10pF trimmer

Resistors (0.25W, 5%)

R1, R10, R15 — 1kΩ
R2 — 47kΩ
R3 — 120kΩ
R4 — 4.7kΩ
R5 — 470Ω
R6, R9, R11, R12 — 22Ω
R7 — 2.2kΩ
R8 — 2.7kΩ
R13 — 82Ω
R14 — 3.3kΩ
R16 — 1.2kΩ
VR1 — 100kΩ 10mm vertical trimpot

Preamplifier Parts

1 BC549 NPN transistor
1 BC559 PNP transistor

Capacitors

2 22μF 10VW tantalum or low-leakage electrolytic
2 0.1μF monolithic
1 33pF ceramic

Resistors (0.25W, 5%)

1 x 330kΩ, 1 x 56kΩ, 1 x 33kΩ, 2 x 10kΩ, 1 x 560Ω

Where to buy the parts

A complete kit of parts for this project is available from:

Oatley Electronics,
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Note: PCB pattern copyright © Oatley Electronics.

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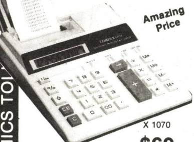

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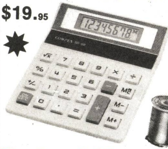

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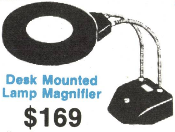

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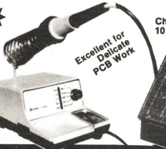

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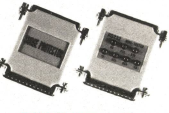

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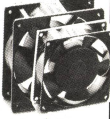

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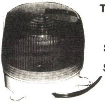

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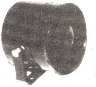

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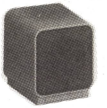

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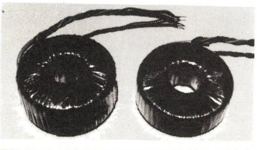

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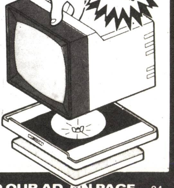

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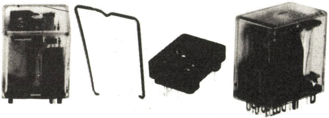

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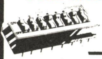
S 4058 for DPDT Relays (S 4067/8) **$2.40 Now $1.50**
S 4059 for 4PDT Relays (S 4070/1) **$2.40 Now $1.50**

OEM Grade Dil Switches



Gold Plated Contacts

		1-9	10-24	25up
S 3045	2 way	1.10	1.00	.90
S 3050	4 way	1.25	1.10	.95
S 3055	6 way	1.50	1.40	1.28
S 3060	8 way	1.75	1.65	1.39
S 3065	10 way	.195	1.85	1.59

Sealed Rotary Switches PCB Mount and Soldertail

A real plus feature is the ability to set the number of stops to suit your own distinct requirements, e.g. A 1 pole 9 position is easily implemented using our S 3021.

1-9 **$2.25** 10-24 **$2.05**
25-99 **$1.90** 100up **$1.70**

S 3021 **1 Pole** Configure from 1 pole 2 position through to 1 pole 12 positions.

S 3022 **2 Pole** From 2 pole 2 positon to 2 pole 6 position.

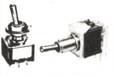
S 3025 **3 Pole** From 3 pole 2 position to 3 pole 4 position.

S 3024 **4 Pole** From 4 pole 2 position to 4 pole 3 position.

Mercury Switch Bargain S 3070

$1.00ea 10Up **.95¢**

Up to 50% Off
Mini Toggle Switches



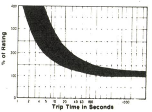
		1-9	10-24	25 Up
S 1010	SPDT	1.90	1.70	1.20
S 1015	SPDT PCB	2.50	2.35	1.85
S 1020	DPDT	2.25	1.95	1.50
S 1025	SPDT centre off	2.25	1.95	1.50
S 1027	SPDT centre off PCB	2.75	2.50	1.80
S 1030	DPDT centre off	2.75	2.50	1.79
S 1035	DPDT PCB	2.75	2.50	1.79
S 1037	DPDT centre off PCB	2.95	2.75	1.89

New for '86-Low Cost Resettable Circuit Breaker

Now there's no need to pay $10 or $12 for a circuit breaker. The all new Altronics product is USA Underwriters Laboratories listed (and that speaks for itself) and once again is an Altronics Price Breakthrough.

Performance Data:

- Will hold 100% of rated current indefinitly at 25 deg.C.
- Will trip within 1 hour at 125% of load at 25 deg.C.
- Will trip within 4-40 seconds at 200% rated load.



		We.	
S 5510	10 amp rated	~~$3.95~~	$3.60
S 5515	15 amp rated	~~3.95~~	3.60
S 5520	20 amp rated	~~3.95~~	3.60

Save 35%
IDC Computer Cable

		Was	Now
W 0616	16 core	2.20	**1.50**
W 0626	24 core	2.95	**1.80**
W 0634	34 core	3.90	**2.50**
W 0650	50 core	7.00	**3.95**

Key Operated Switches

For Security Systems etc.

Single Pole **S 2500** **$4.95**
10 up **$4.00 ea**

4 Pole **S 2510** **$7.95**
10 up **$6.20 ea**

Million Diode Sellout!
From 1.5¢ each

Altronics have just purchased around 1 Million (yes million) factory fresh, premium quality IN914/IN4148 diodes. These became surplus to Fairchild Australia as the factory supplied bulk, loose pack diodes instead of the tape/reel diodes ordered. So unless you are a manufacturer with automatic component insertion equipment, these fine quality diodes represent the diode bargain of all time!! **Cat. Z 0101**

1-99	**3¢ ea**
100-499	**2.5¢ ea**
500 plus	**1.5¢ ea**

Stereo Mixers at Low Import Price

ATTENTION — Social Clubs, Schools, Churchs, Disco Operators, Entertainers, Hotels, Night Clubs and Sporting Bodies. With Altronics low prices - here is your opportunity to install one of these outstanding sound control mixers. Both models include microphone "Soundover" facility - making either ideal for live entertainment use.

Stereo Audio Mixer

A 2550

$125

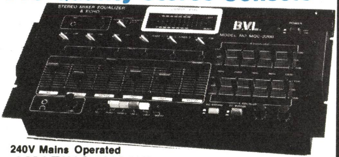
240V Mains Operated

This brilliant little mixing console is absolutely packed with features. Allows blending of Microphone, two Phono inputs and either two Tape or Turner inputs • Right and left VU meters • Separate Bass and Treble controls • 5 slide level controls • Fader control between Phono pickups for professional cueing • Headphone monitor switch • Talkover facility.

SPECIFICATIONS:

• **Input** Mic 0.5mV 600 Ohms Phono 3mV 50K Ohms Tape/Tuner 150mV 100K Ohms • **Output** 250mV •**Frequency Response** 20Hz to 20Hz (plus or minus 1db) • **Tone Control (Treble)** 10KHz (plus or minus 12db) • **Tone Control (Bass)** 100Hz (plus or minus 12db) • **Distortion** Less than 0.07% • **S/N Ratio** More than 60db • **Headphone Impedance** 4—6 Ohms • **Dimensions** 318 (L) x 217 (W) x 85 (H)

Pro-Quality Stereo Console



240V Mains Operated

AMAZING VALUE A 2570 **$399**

Our sophisticated 'NEW' Audio Mixing Console is ideal for 'live' recording • PA mixing • Fantastic Tape recordings • Even Stereo/Mono VCR recording. A truly professional deck that features separate R/L 5 band graphic equalisers • Echo and Peak LED level indicators • Talkover facility • Separate H/Phone level control • Patch switch bank • Individual microphone, Phono 1 Phone 2, Aux/Line 1, Aux/Line 2, and Master slide level controls. — Blend up to two magnetic or crystal turntables, two tape decks or tuners and two microphones all at once!!

SPECIFICATIONS:

• **Input** Mic 1—0.5mV 600 Ohms Mic 2—0.5mV 600 Ohms Mic 2—0.5mV 600 Ohms (low imp.) 2.5mV 10K Ohms (low imp.) Phono 1 & 2 (Mag) 3mV 50K Ohms Phone 1 & 2 (Cry) 150mV 100K Ohms Tape/Tuner 1 & 2 150mV 100K Ohms • **Equaliser** 5 frequency bands—60Hz, 250Hz, 1KHz, 4KHz, 12KHz—Boost Cut range-plus or minus 12db @ Centre frequency. • **Output** 1.5V/0.775V (Selectable) • **Frequency Response** 20Hz to 20KHz plus or minus 1db • **Distortion** Less than 0.05% • **S/N Ratio** More than 50db • **Headphone Impedance** 4—16 Ohms • **Echo** B.B.D.System • **Delay Time** 30—200mS • **Echo Repeat Control** • **Delay Time Control** • **Dimensions** 480 (L) x 240 (W) x 110 (H)

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FOR DESPATCH P&P CHARGES AND ADDRESS DETAILS PLEASE REFER TO OUR AD. ON PAGE 84 •

Radar Sensation Radar Sensation

Invisible from outside your vehicle these fantastic high spec detectors simply clip onto the sunvisor

Now X band, K band stationary, gun or even Mobile Radar are detected **up to an amazing 13Km** with the all new "space age" **Microeye Radar Detectors** The very Ist in the world to utilize a custom microprocessor—hence enabling quite incredible sampling/checking detection of incoming signals — and what's more they are so light and compact they simply clip securely on to your sunvisor out of sight of anyone outside the vehicle.

Detects X Band, 10.525Ghz and K Band 24.150Ghz to an incredible range of 13KM. Gives both audible and visual alarms with a built-in Automatic Mute Control that decreases the volume after six seconds of activation.

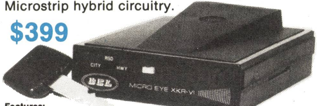
• **Fully automatic self test in-built** to allow you to ensure all lights and alarms are operational upon power up of your vehicle • **Simply plugs into your cigarette lighter socket** or can be direct wired into your existing car wiring • **Clips onto sunvisor,** thus eliminating the shadowing effect the bonnet area causes where detectors are mounted on the dash. Virtually eliminates the chance of theft, as unit is up out of sight • Features a quick release from the visor bracket to allow you to remove for safety • Using the latest digital processing technology the unit will filter out and ignore emissions from 80% of poorly designed Radar Detectors that emit microwaves.

• **Detects Mobile Radar Equipment** even monitors the pulse which is sent to the road from the Police vehicle to enable them to accurately calibrate their own speed • Not only picks up signals in straight lines but from just about any angle as well as around corners and over hills • **Highway/City Modes** switch allows monitoring of City or Highway conditions. By measuring and storing the field strength of each microwave sample taken from the source, the microeye will automatically, whilst in City Mode, discriminate between Microwave Alarm Systems and Radar Traps etc., Thus reducing false alarms when driving in Microwave congested areas i.e Towns etc. • Any Radarsignal received by the unit whilst in the Highway Mode will instantly trigger the alarm.

Microeye Standard Model A 1510

Incorporates exclusive superheterodyne Horn Microstrip hybrid circuitry.

$399



Features:

- Separate audio alerts for X and K bands.
- RSD (Radar Signal Discriminator) switch to eliminate extraneous signals with an LO and LR positions. The amber LED pulses to indicate LO and LR positions.
- Alarm: Red LEDs will light up in sequence as signal strength increases. When all Red LEDs are lit and signal strength continues to increase, all Red LEDs will flash simultaneously.

Accessories Included:

- Dash/Visor bracket
- Velcro
- Cigarette lighter plus

Specifications:

Size: 3/4" H x 3-1/8" W x 4-1/2" L
Operating Frequencies: X band: 10:525 GHz
K Band: 24:150 GHz + 110 MHz
Antenna Type: Microwave Horn, single ridge waveguide
Power Requirements: 12V DC nominal, 10-14V limits
Current: 190mA
Temperature Range: 12 deg.C to + 70 deg. C

Microeye Deluxe Model With Extra Filter A 1520

3db extra sensitivity and reduced interference

Similar to Model A 1510 but with an additional switchable filter to further reduce the annoyance of interference from microwave door openers, burglar alarms etc. which operate on the same frequency as police Radar. (The addition of this filter has enabled an increased sensitivity in City Mode of approx. 3db).

A Simply Great Detector $449

Installation

An absolute Cinch! Clip it on the passenger side visor and plug the power lead plug into your cigar lighersocket and you're up and running. (I took a few more minutes to secrete the wiring behind mouldings etc. and connected into the ignition wiring, thus hiding all wiring).

The Ultimate a GaAs Diode Detector

(Gallium Arsenide)

MICRO EYE VECTOR

The First Detector with GaAs Diodes

We believe the Vector to be one of the finest and most sensitive Radar Detectors available in the World today. Approximately 4db greater sensitivity than the A 1520.

Until now, GaAs diodes have only been used in sophisticated military radar equipment. The Microeye Vector is the first consumer electronics product equipped with this new technology.

Why GaAs Diodes Make The Difference:

- Lower threshold allows for a better signal to noise ratio.
- Lower signal conversion loss.
- Higher barrier reduces noise

Quite simply, GaAs diodes increase the sensitivity of the Microeye Vector.

Features:

- Separate audio alerts for X and K Band.
- Three operational switches: **Power:** On and Of; RSD (Radar Signal Discriminator) to minimize extraneous signals with a LO (local) position and a LR (Long Range) position; **Filter** Mode designed for instant computerized analysis of incoming signals with LO and LR positions.
- Alarm: Red LEDs will light up in sequence as signal strength increases. When all Red LEDs are lit and signal strength continues to increase, all Red LEDs will flash simultaneously.

Accessories Included:

- Visor bracket
- Velcro
- Cigarette lighter plug

Specifications:

Size: 3/4" H x 3-1/8" W x 4-1/2" l.

Operating Frequencies:	X Band: 10:525 GHz K Band: 24:150 GHz +110 MHz
Antenna Type:	Microwave Horn, single ridge waveguide.
Power Requirements:	12V DC nominal, 10-14V limits.
Current:	190 mA
Temperature Range:	-12 deg. C to +70 deg.C (+10 deg.F to +158 deg.F)

A 1530

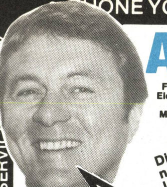
$499

Great technology in a small Package

21 Day Money Back Guarantee

These detectors are unconditionally guaranteed to demonstrate a high order of efficiency/sensitivity and thus provide you, the motorist, with a corresponding level of awareness of Police Radar. Should you be less than delighted with your purchase, you may return to us for a full refund within 21 days of purchase. Returns must be in original, as sold condition and include all accessories, instructions etc.

HONE YOUR ORDER — ALTRONICS TOLL FREE 008 999 007 •



ALTRONICS PRESENTS

For full details see Electronics Australia Magazine May, June, July '86

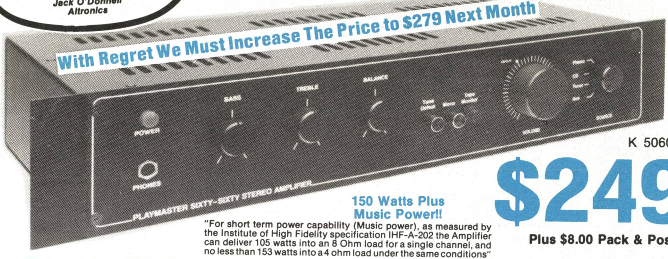
Distortion at normal listening levels is typically .005%

In many respects the performance of this fine design cannot be exceeded by commercial Amplifiers costing $1000 and more.
My personal congratulations to John Clarke and the design team at Electronics Australia
Jack O'Donnell
Altronics

THE PLAYMASTER 'SIXTY — SIXTY' INTEGRATED AMPLIFIER KIT

Never before has such a high performance Amplifier been so affordable or so easy to build. It's hard to imagine even the most ardent Audiophile being less than delighted with the audio purity of this fine Amplifier.

With Regret We Must Increase The Price to $279 Next Month



K 5060

$249

Plus $8.00 Pack & Post

150 Watts Plus Music Power!!

"For short term power capability (Music power), as measured by the Institute of High Fidelity specification IHF-A-202 the Amplifier can deliver 105 watts into an 8 Ohm load for a single channel, and no less than 153 watts into a 4 ohm load under the same conditions"

Features of the Sixty-Sixty

★ 60 watts per channel with both channels driven into 8 Ohm loads ★ Very low noise on phono and line level inputs—better than CD performance ★ Very low harmonic and intermodulation distortion ★ Excellent headroom ★ Tape monitor loop ★ Tone controls with centre detent and defeat switch ★ Mono/stereo switch ★ Toroidal power transformer ★ Easy-to-build construction ★ Very little wiring.

Perfect CD Player Companion

Hum and noise levels for line level I/P is actually better than any currently available CD player at 103db plus. You can't hear a thing with your ear right on the speaker cone and the volume up full!! The volume control is calibrated "CD Clip" at a level corresponding to 2V signal level or full amp output power with CD player input.

PERFORMANCE SPECIFICATION

Power Output - (One Channel) 4 ohms 88W, 8 ohms 74W - **(both channels)** 4 ohms 72W, 8 ohms 62W

Harmonic Distortion - Less than .01% for all powers up to 60W into 8 ohm loads — Less than .015% for all powers up to 70W into 4 ohm loads.

Intermodulation Distortion — Less than .01% for all powers up to 60W into 8 ohm loads — Less than .012% for all powers up to 80W into 4 ohm loads.

Frequency Response — *Phono Inputs* - RIAA/IEC equalisation within + - 0.5db from 40Hz to 20kHz *Line level Inputs* — -0.5db at 20Hz and -1db at 20kHz

Input Sensitivity — ★ Phono inputs at 1kHz - 4.3mV (overload capacity at 1kHz - 140mV), ★ Line level inputs — 270mV

Hum & Noise — ★ Phono (with respect to 10mV at 1kHz) - 89db unweighted, with typical moving magnet cartridge. ★ High level inputs (with respect to 270mV) - 103db unweighted with 20Hz to 20kHz bandwidth.

Tone Control — Bass — +-12db at 50Hz

Treble - +-12db at 10kHz

Damping factor - At 1kHz and 30Hz - greater than 80

Stability — Unconditional

It Looks So Good Your Friends Won't Believe You Built It!

> **"This New Amplifier offers a standard of performance far ahead of anything we have previously published and ahead of most commercial integrated Stereo Amplifiers".**
> **"It is half to one third of the cost of an imported Amplifier with equivalent power output and performance".**
>
> *Says Leo Simpson*
> *Managing Editor*
> *Electronics Australia*
> *Magazine*

Our Very Finest Kit to Date

The Altronics Kit K 5060 is our very finest Kit product produced to date. The chassis, PCB and front panel are all pre-drilled and punched, everything fits beautifully. The end product is protective packaged in foam styrene - we guarantee it will arrive in perfect shape even if it does get accidently "dropped" along the way.

Money Back Guarantee

Should you buy the kit and before commencing construction, you feel that the task is beyond you simply return to us in **as sold condition** with all packaging and instructions and we will refund your purchase price less transport charges.

Beginner Constructors can Build this Amplifier

If you can use simple hand tools and a soldering iron you can build this project. The designers at EA believe (as we do) that many 1000's of audio enthusiasts, with little or no electronic constructor experience would want to build this amp — so its designed on one large printed circuit board. Virtually everything is board mounted i.e. even input sockets and switches!! There is no shielded wire, in fact there is only a handfull of soldered connections external to the PCB. So by simply following the step by step instructions and inserting components with the pre-drilled PCB and soldering thereafter the amp is thus constructed. **YOU WILL BE PROUD OF THE END RESULT—AND IT WILL LAST YOU A LIFETIME.**

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Your Last Chance For A Quality Altronics Kit At These Prices

Due To Huge Component Price Increases

Build this Fantastic Amp Kit

NO COMPROMISE DESIGN

Ultra Fidelity Series 200 Mosfet Integrated Amplifier

$439

INCREDIBLE VALUE

FEATURES: — This brilliantly designed stereo amplifier will equal or better just about any integrated commercial amp regardless of price. It is a no-compromise design capable of delivering 100 watts per channel at very low distortion. Four basic stereo inputs are provided for both moving magnet and moving coil cartridges. Also three high level stereo inputs are provided for compact disc players, AM/FM tuner and auxiliary input which could be from a stereo TV tuner of Hi Fi VCR. Input facilities are also provided for two stereo cassette decks and full monitoring facilities are available for either deck plus dubbing from Deck 1 to Deck 2 or vice versa. • Full CMOS Analog switching (soft touch) • Twist Type speaker lead binding posts supplied • De-thump muting in-built • All Hi-Spec low noise IC's used. • Incredibly accurate RIAA equalisation. • No control wiring whatsoever • Led indication of switch status (on/off) • All components mount on the PCB, even pots and sockets • Super efficient Toroidal Transformer—Low Hum • Uses Hitachi Mosfet Power devices • In-built over drive protection • Centre detents on Bass, Treble and Balance controls; multiple detents on volume control. • Heavy Duty Heatsinks.

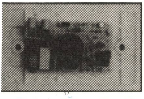
SPECIFICATIONS: —
Power Output: 100W RMS into 8 Ohms (per channel) **Freq.Response: 8Hz to 20KHz** +0 -0.3db 2.8Hz to 65KHz +0 -1db **Input Sensitivity: 0.775mV for full power Hum:** -100db below full output **S/N Ratio:** 94db flat -100db A-weighted **Distortion:** 0.01% @ 1KHz **Stability:** Unconditional Cat K 5030

Lamp Saver For Spotlights

Does your house eat lamps? Are you always replacing those expensive hard to get to lamps? This kit solves your problems. Cat. **K 6330**

Features:
Soft Start. Voltage derating. Over voltage protection. Installs onto rear of standard size switch plate.

(See EA June '86) **$15.95**

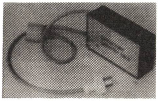


Drive Way Sentry

Automatic switch on via car headlights. Automatic switch off after 4 mins. Inhibited during daylight hours. External trigger switch. i.e. manual override.

This kit gives you half a chance of making it from the garage to the front door without tripping over the dog or the kids' bikes in the dead of night. Cat. **K 1950.**

(See EA March '85) **$39.50**



EA Drill Speed Controller MK 11

For Universal Brush Type Motor Drawing up to 3 Amps

Varies motor speed from a few RPM to full speed while maintaining good torque. Suitable for - Drills and Drill Presses - Circular Saws - Jig Saws - Food Mixers - Movie Projectors.

"A Must For The Home Handyman"

K 6005 **$19.95**

Bench Amplifier

Invaluable for testing all your audio projects. This amplifier is a well proven design with low distortion and high reliability.

One of the most useful pieces of equipment in an Electronic workshop is a simple Amplifier Module to test circuits.

K 2105 **$16.60**

- 250 Milli watts output into 4 Ohms
- Runs off single 9V supply
- Can give 0.5 watts when run on 12V + heatsink
- Complete kit housed in "ABS" Jiffy Box.

13.8V High Current Supply

Massive 10 Amps

Ideal for Radio Amateurs-Will Power Your Mobile Rig Back At Home

★ Output 13.8V DC 7.5A Continuous - 10A Intermittent ★ Regulation: - 0-7.5A - 50mV. Now includes - Custom Designed Printed Circuit Board as opposed to Vero Board in original article. ★ Supplied in a quality instrument case - attractive silk screened front panel ★ LED overload indicator.

Cat. **K 3250**

$119.95

Bench Top Power Supply

3-30V to 1 amp Max.with variable current limit

$69.50

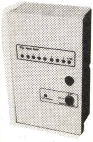
FEATURES:
★ Output 3 to 30V at 1A ★ Short circuit protected ★ Load switching ★ Current limiting. Dual scale meter ★ Housed in our Deluxe "ABS" instrument case.

SPECIFICATIONS:
★ Output Voltage - 3 to 30V ★ Output Current - 0 to 1 amp (fully variable) ★ Load Regulation - Better than 0.2% from 0 to full load ★ Output Ripple-Less than 2mV RMS. Cat. **K 3210**

Super Low Price on Famous EA 8 Sector Alarm System Kit

(See EA Mag.Jan '85)

Fantastic Value



FEATURES:
Alarm has 8 separate input circuits - 8 sectors can be monitored independenty. Each input circuit is provided with an indicator LED and a sector On/Off switch. Individual sector isolation. Inputs accept both normally closed and normally open sensors. Two Inputs provided with an entry delay (between 10-75 sec.) Internal trip warning buzzer - alerts owner/ocupant of pending alarm operation - great for the "forgetful" amoungst us. This buzzer is pre-settable between 5 and 55 seconds prior to Alarm. Unique circuit detects automatically when any N/O or N/C loops are either open circuit or dead short. **e.g. someone trying to bridge reed switches etc.** Switched output can be used to send a silent alarm through an auto-dialler circuit or similar. Full battery back up via. 12V - 1.2Ah battery. Supplied in an attractive functional security case.

Save $$$ on the cost of commercial equivalents

Within the Capacity of the beginner constructor

K 1900 (without Backup Battery) **$119.50**

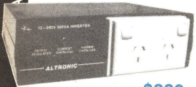
S 5065 12V 1.2AH Backup Batte **$22.95**

240V Mains Power From Your 12V Battery

300 Watt Inverter with Auto Start

(See EA Sept.'85)

Just think how handy is would be to have 240 Volt AC Mains Power when camping or for your boat or Caraven.
Auto Start draws power from your battery only when appliance is plugged in and "turned on" i.e. battery can be left permanently connected if desired.
Thermal Over Load. Current Regulated. Current Overload.



K 6752 Complete Kit **$229**

K 6754 Fully built & tested **$289**

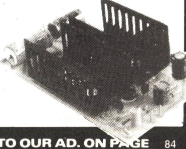
20 Watt Utility Amp Module

All components mount entirely on one printed circuit board, even the heatsinks!

SPECIFICATIONS:
Input Impedance 100K ohm approx. **Output Impedance** 0.1 ohm approx. **Signal to noise ratio** 58db with respect to 1 Watt **Frequency Response** -3db @ 45Hz & 68KHz **Load Impedance** 4 ohms or Greater **Quiescent Current** 22mA with 8 ohm load.

DC Supply	PWR/8 ohms	PWR/4 ohm
20V	4W	6.6W
30V	8W	12W
35V	15W	19W

K 5045 **$17.95**



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Ring Your Order Now Toll Free & Save Up To 30% With These Prices

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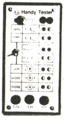
Transistor Tester



For In Circuit Testing "NO NEED TO UNSOLDER SUSPECT TRANSISTORS"

$16.50

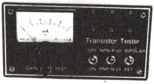
Have you ever de-soldered a suspect transistor, only to find that it checks out OK?

FEATURES:
★ Tests both NPN andPNP transistors in circuit at the touch of a swith ★ Tests Diodes and SCRs as well ★ No need to switch between NPN and PNP — its automatic ★ LED indication to show condition of device. Cat. **K 2530**

Transistor and Fet Tester

Electronics Australia Project. Tests Bipolar Transistors, Diodes, Fets, SCR's and PUT's Excellent service aid for the hobbyist and serviceman. Complete Kit and instructions. Cat. **K 2525**

$23.95



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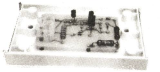

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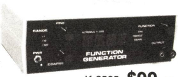

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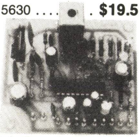

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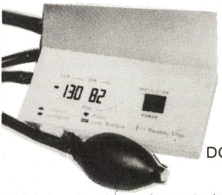

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New Model

X 3055

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	: 40-150 Pulse/Min. Pulse Rate
Acuracy	: Pressure + 3 mmHg (Confirmed A. A. M. I.)
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Deflation Method	: Pre-Settable Exhaust System
Exhaust	: Manual Valve

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Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible, the circuits have not been built and tested by us. As a consequence, we cannot accept responsibility, enter into correspondence or provide constructional details.

Whistler stopper for PC Birdies

The PC Birdies project described in *Electronics Australia* in May 1981 works fine, but the continuous chirping soon drove the household crazy. This circuit overcomes the problem by automatically turning on the PC Birdies circuit for a short period approximately every hour.

The controller has two modes of operation: light activated and manual. In the light-activated mode, the PC Birdies sound only during daylight hours or under artificial lighting. In the manual mode, the circuit operates regardless of lighting conditions. No modification to the PC Birdies circuit is required, as the controller switches power only.

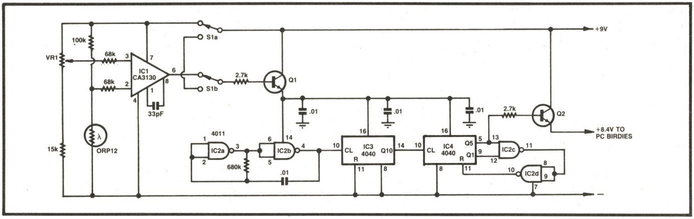
The light-switch consists of IC1, a FET op amp configured as a comparator. VR1 is used to set the trigger level, while an ORP12 light dependent resistor (LDR) is connected to the other input. When the comparator switches, Q1 turns on and switches the positive supply to IC2, IC3 and IC4. S1 provides manual override of the light-switch by switching the base of Q1 directly to the positive supply via a 2.7kΩ resistor.

IC3 and IC4 form a divider chain, with 10Hz clock signals supplied by IC2a and IC2b. IC3 is a 4040 12-stage counter which divides by 1024, while IC4 divides by 32 at the Q5 output. When this output goes high, Q2 turns on and supplies power to the PC Birdies' circuit.

IC2c and IC2d provide the reset function which occurs some 3.4 minutes later. What happens is that Q1 goes high two clock pulses after Q5 goes high. This in turn forces pin 10 of IC2d high, thus resetting IC4.

R. Sinclair,
Baulkham Hills.

$15



Amplitude Modulation for the Function Generator

In EA May 1986, two circuits were published showing how to provide frequency and amplitude modulation for the Function Generator. Although the circuit for amplitude modulation is theoretically correct, the results would be less than satisfactory as it does not provide the correct bias at pin 1 of the XR2206.

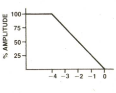
The correct conditions for a given AM input signal can only be achieved if pin 1 of the XR2206 varies between 0V and −4V. This circuit is designed for a nominal maximum AM input of 1V, which provides a maximum output of −4V from voltage follower IC1b. Note that the connection between pin 1 of the XR2206 and the −5V rail is broken and a 56kΩ resistor installed.

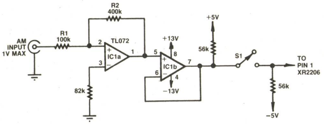
When S1 is closed, the two 56kΩ resistors bias pin 1 of the XR2206 to half-supply, thereby reducing the output amplitude of the Function Generator to zero. The output can then be restored to maximum in a linear fashion by increasing the bias voltage to −4V (ie, an AM input signal of 0.5V gives 50% maximum output; an input signal of 0.75V gives 75% maximum output; and so on).

IC1a acts as an inverting amplifier with a gain of four, as set by the ratio of R2 and R1. Alternatively, these two resistors can be selected to give a maximum output of −4V on pin 1 if the AM input signal is between 1V and 4V. Note that the input impedance should not be less than 100kΩ, and that the op amp supply pins are connected to ±13V supply rails at the inputs to the 3-terminal regulators.

S. Kamaldeen,
Hobart, Tas.

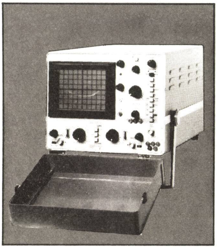
$15





20MHz OSCILLOSCOPES

With Component Tester



The APLAB oscilloscope Model 3132 is a dual trace 20 MHz scope with minimum sensitivity of 2mV/div and minimum sweep speed of 0.5 us/div.
Triggering modes include TV line or TV frame sync.

Other features include:

- Built in triple DC source +5V +12V ±12V
- Dual component tester comparator.

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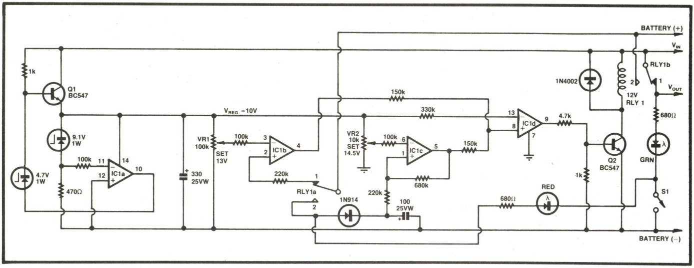
Circuit & Design Ideas



Battery Charger Controller

Users of lead acid batteries should be interested in this simple battery charge controller. It allows battery charging whenever the battery voltage is below 13V and disconnects the battery from the charger when battery voltage reaches 14.5V. Typical chargers include solar panels and mains powered chargers.

An LM3900 quad Norton op amp is used for voltage regulation, voltage comparison and finally as an OR gate. A relay is used to switch the battery to the battery charger.

IC1a is used as a voltage regulator and, in conjunction with Q1, sets the voltage of Vreg to about 10V.

IC1b monitors the battery voltage when the relay is switched off via the RLY1a position 1 contact. When the voltage drops below 13V, the output of IC1b switches the output of OR gate IC1d high. This turns on transistor Q2 to switch the relay.

At this stage, the battery is connected to the battery charger via relay contact RLY1b in position 2. IC1c now monitors the battery voltage via the RLY1a contact at position 2.

When the battery voltage reaches 14.5V, IC1c switches the output of IC1d low to switch off the relay. This disconnects the charger from the battery.

Note that when the charger is disconnected from the battery, the charger voltage is directed via the RLY1b contact to Vout. This voltage can then be used to operate a similar charger circuit.

The LEDs are used to indicate the charger status. The green LED Indicates when the charger is disconnected from the battery and the red LED indicates that the charger is charging the battery.

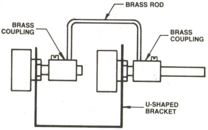
Setting up is simply a matter of adjusting VR1 and VR2 so that the relay switches on with battery voltage below 13V and switches off above 14.5V. Note that if a mains operated charger is used, a 4700μF/25VW capacitor or larger should be connected between Vin and ground.

Note also that the relay's current rating should suit the likely charge current and that the relay should be remote from the battery, to avoid the risk of explosion.

W. Jolly,
Nambucca Heads, NSW.

$20

How to gang single potentiometers



This idea will be of interest to anyone thinking of building the High Performance Audio Generator (EA May 1986). It can be used in any application requiring an unusual combination of potentiometer values.

All that is required is a couple of brass shaft couplings, some 3mm rod and a U-shaped bracket.

The U-shaped bracket should be of heavy gauge material because the support for the front potentiometer must be narrow enough to allow the link to traverse the full arc of the potentiometer.

Suitable shaft couplings can be made up by drilling and tapping pieces of 12mm brass rod. The link was made from 3mm bronze welding rod.

A reverse log potentiometer can be obtained by mounting a standard log unit with its shaft pointing away from the front panel.

J. Emery,
Bull Creek, WA

$10

Cells and batteries: we survey the field

In a few years time, the science of electrochemistry and its offspring the electric power cell will be 200 years old. At the start of this long evolutionary period things moved very slowly. In the last two or three decades however, our knowledge and understanding of the processes involved when we change chemical energy directly to electrical energy have been revolutionised. As a result, many exciting new power cells and batteries, with specifications which would have seemed impossible a few years ago, are now becoming available.

by TERRY AYSCOUGH

Basically, an electric cell is a container which holds two different electrodes and a special type of liquid called an electrolyte as shown in Fig.1.

One electrode, called the anode, is usually metal. The other, called the cathode, is usually a metallic oxide. Some of the latest cells use gas or liquid cathodes instead of metallic oxides, as we shall see later.

Modern convention is to call the electrode connected to the cell's positive output terminal the cathode and the one connected to the negative output terminal the anode. This is the reverse of the convention used in electronics whereby the anode of a device is the positive terminal.

Both anode and cathode are built around current collectors which are immersed in the electrolyte solution containing lots of ionised atoms. Electrolytes are often water solutions, but in some cells, other liquids and occasionally, even solids are used.

The anode material is chosen to have a much higher affinity for oxygen than the cathode. This causes the anode to gain oxygen (or become oxidised) and the cathode to loose oxygen (or become reduced) as the cell operates. These reduction and oxidisation processes are called redox reactions.

Continuing redox reactions can only occur when there is an external circuit for electron flow between the anode and cathode. In order for the oxygen atoms to combine with metal atoms in the anode, they must give up electrons. These are picked up by the anode's current collector and flow via the external circuit to the cathode, providing a useful electric current in the process. Chemical activity within the cell will continue to supply this current until the cathode has been stripped of nearly all its oxygen and the anode has been correspondingly oxidised. When this occurs, the cell is exhausted and must either be recharged or replaced, depending on its type.

Cells which are thrown away when exhausted are called primary types and those which can be recharged and used again are called secondary types or sometimes storage batteries or accumulators.

A single cell will provide an output of only about 1.5V so groups of cells are connected in series to form batteries. Unfortunately, the word 'battery' is used by consumers regardless of whether they contain one or many cells. In this article we will stick to the correct use of 'cell' and 'battery'.

Although the beginnings of cell technology go back to the late 1700s, it is only in recent years that a true understanding of the complex electrochemical reactions involved has emerged. This has led to dramatic improvements in the variety and efficiency of cells, as we will see in the following sections.

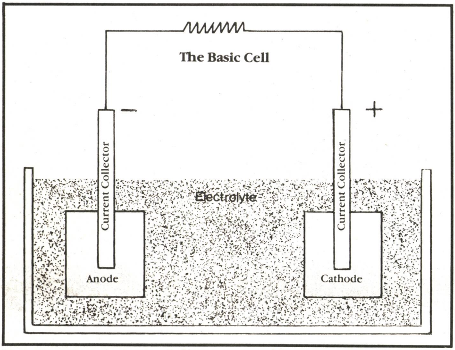


Fig.1: Shows the basic electric cell. Picture courtesy of Duracell.

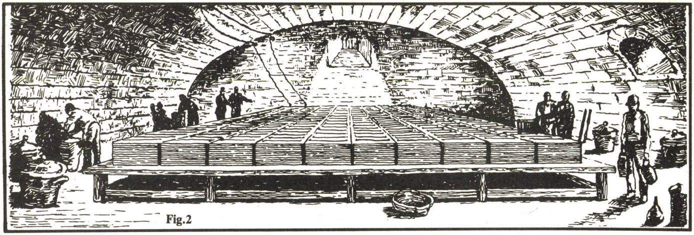


Fig.2

Early beginnings

The science of electrochemistry had its beginnings between 1790 and 1800 when Alessandro Volta, following up earlier work by fellow Italian Luigi Galvani, constructed his famous Volta pile. This was the world's first battery and consisted of discs of silver and zinc interleaved with absorbent material which could be soaked with an electrolyte, such as brine. The voltage produced when an electrode is immersed in an electrolyte is still known as a Galvanic potential and Volta's name is remembered by its use for our unit of electromotive force or Volt.

Following Volta's discoveries, many different types of cells were investigated. In 1813 a huge battery containing 2000 pairs of plates and with a surface area of 82 square metres was constructed in the cellars of London's Royal Institution. See Fig.2. Michael Faraday later used power from this battery for many of his famous experiments with electromagnetism.

The first really practical cell was developed by Frenchman Georges Leclanche during the 1860s. The original Leclanche system used a zinc rod as the anode and a mixture of manganese dioxide and powdered carbon contained in a porous cup, as the cathode, see Fig.3. A carbon rod running down the middle of the cup served as the cathode current collector. Both electrodes were placed in a glass jar filled with a solution of water and ammonium chloride which acted as the electrolyte. These cells gave an open circuit terminal voltage of about 1.5V.

Many early cells suffered from a problem known as gas polarisation. Whilst the cell was in use, bubbles of hydrogen gas formed on the cathode surface and gradually built up an insulating layer. As a result, the internal resistance increased and output current declined.

Leclanche's use of manganese dioxide as a 'de-polarising agent' overcame the problem and at the time, it was assumed that the oxygen-rich de-polariser was absorbing hydrogen bubbles as they were formed. Recent research has shown however, that because manganese dioxide is a more efficient cathode material than most simple metals, it gives a Galvanic potential above the voltage at which hydrogen is formed.

Over the years, various improvements to the physical construction and chemistry of Leclanche cells were made. These included developing the shape of the zinc anode, firstly into a cylinder and later into a can, which could be used as a container for the whole cell. In 1888 an unspillable ammonium chloride paste was developed to replace the liquid electrolyte, enabling cells to be sealed and leading to the basic zinc carbon 'dry' cell as we know it today.

Many tens of thousands of Leclanche cells were manufactured to the original

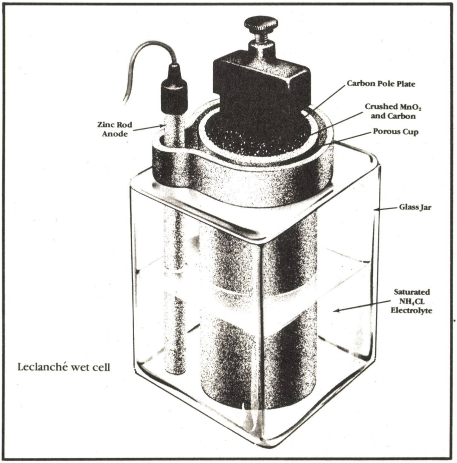
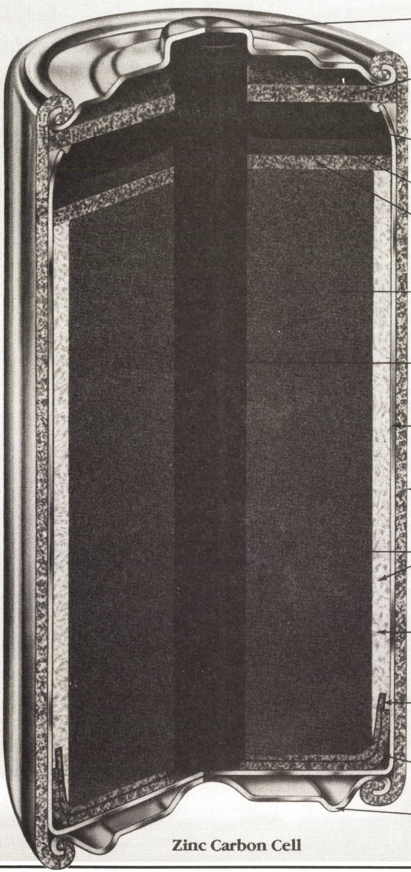


Fig.3: The Leclanche wet cell had a carbon rod as the cathode current collector. Picture courtesy of Duracell.



Metal Cover (Positive Terminal)
In contact with carbon rod

Vent Washer
Paperboard. Allows escape of gases but holds back any electrolyte entering air space as a result of asphalt seal failure.

Air Space
Aids escape of gas.

Asphalt Seal

Support Washer
Polyethylene-coated paperboard. Supports asphalt seal.

Cathode
Mixture of powdered manganese dioxide (MnO_2), carbon black and electrolyte.

Cathode Current Collector
Carbon rod.

Anode
Zinc can serves both as anode and as cell container.

Jacket
Polyethylene-coated kraft paper and polyester film label.

Electrolyte
Solution of ammonium chloride (NH_4Cl) and zinc chloride ($ZnCl_2$) absorbed in separator and in cathode (but not in anode).

Separator
Pastelike "sleeve" of flour and starch between anode (can) and cathode mix. Saturated with electrolyte.

Insulating Cup
Kraft paper. Helps center the cathode during assembly and prevents it from touching anode.

Star Bottom
Paperboard. Aids insulating cup.

Metal Bottom (Negative Terminal)
Tin-plated steel, in contact with zinc can.

Zinc Carbon Cell

Fig.4.

design. Initially they powered the rapidly growing railway and post office telegraph systems and later the early telephone networks.

The market for dry Leclanche cells was boosted by the invention of the 'flashlight' in 1900. At that time, dry cells had only a fraction of the capacity they do today, so hand torches were only flashed on and off occasionally to conserve the limited power.

Standard zinc carbon cells and batteries

The classic zinc carbon cell has been in production for nearly 90 years and is still one of the most popular types for ordinary consumer applications. Operating on the same principles as the Leclanche cells of last century it uses zinc for the anode (negative terminal), and manganese dioxide for the cathode (positive).

The choice of zinc as an anode material by many early experimenters was fortuitous, as we now know that it provides one of the highest negative Galvanic potentials found in common metals. In addition, it is cheap, can easily be formed into the required shape, is relatively strong and chemically stable. Zinc is by far the most common anode material used today, although it is now being challenged by more exotic metals such as cadmium and lithium, which will be covered later.

Manganese dioxide is also still holding its own as a cathode material in ordinary consumer cells and batteries, because it has proved to be a very efficient provider of oxygen in redox reactions. Cells for specialised applications however, use a wide variety of other metallic oxides, liquids and even gases as the cathode material.

(Although we generally refer to Leclanche-type dry cells as zinc carbon types, the carbon acts only as a current collector for the manganese dioxide cathode and does not play a significant part in the redox reactions which generate electric current.)

Different types of cells are often identified by employing chemical notation for the anode and cathode materials used. The symbols for a Leclanche-type cell are $Zn\text{-}MnO_2$, with Zn indicating the zinc anode and MnO_2 the manganese dioxide cathode. The electrolyte in standard zinc carbon cells is usually a solution of water, ammonium chloride and zinc chloride. This produces an acidic mixture containing plenty of ions, so the electrical conductivity is good and current can flow between electrodes inside the battery with minimum losses. Other types of cell may use alkali solutions to produce good ionic conduction in the electrolyte, as we will see in the next section.

A major factor in the continuing popularity of zinc carbon cells is their low cost. The use of the zinc anode to also provide the case for the cell helps keep prices down, but can result in problems. If the zinc fails to oxidise evenly during discharge, corrosion can be excessive in certain spots and pinhole perforations may occur. This is one of the reasons why old and new cells should never be used together. If a partially discharged cell is placed in circuit with new cells, the anode may be forced to oxidise beyond normal limits, resulting in electrolyte leakage and a sticky corrosive mess to be cleaned up.

Fig.4 shows the construction of a typical modern zinc carbon cell. The inside of the can is coated with a thick paste made from flour, starch and electrolyte solution, which acts as a separator between anode and cathode.

The compressed manganese dioxide cathode is also impregnated with electrolyte solution and has carbon black added to assist current flow to the carbon rod current collector. Steel caps at the top and bottom of the cell improve its strength and provide connections to the external circuit.

Most primary cells are cylindrical and there are two good reasons for this. Firstly, a cylinder is one of the most convenient shapes to manufacture, either by extrusion or moulding and to assemble using automatic machinery. Secondly, it is chemically efficient to have the active materials completely wrapped around each other for maximum interaction.

If a number of cells are to be assembled together to make a battery however, cylinders waste a lot of space, so carbon zinc cell packages are often used in batteries giving 6V or more. Their electrochemistry is identical to that for cylindrical cells described above, but their construction is quite different. Each cell consists of a large square or rectangular pellet of electrolyte impregnated manganese dioxide with a thin zinc plate anode in contact with its lower surface. The other side of the plate is covered with either a thin coat of carbon or a graphite filled plastic sheet, which forms the current collector for the cathode of the cell below. Stacks of cells are assembled, one on top of another, to give the required battery voltage.

The open circuit voltage of a zinc carbon cell is 1.5V but on load this falls steadily with time. Optimum performance is obtained at light to moderate discharge rates interspersed with rest-periods to enable recovery to occur. Some typical figures for a D-cell (see Table 1 below) will help illustrate the point.

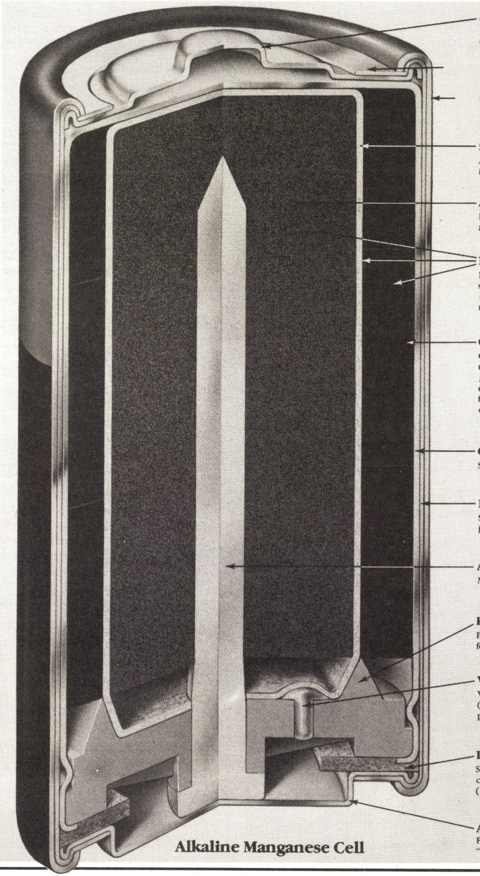
In the right hand column the load current and useful hours of life have been multiplied together to give a total energy output or capacity figure. This is usually expressed in milliampere-hours (mAh) for small primary cells and batteries or in ampere-hours (Ah) for larger rechargeable batteries.

The cell gives only one third of its maximum possible energy output when supplying a current of 300mA for two hours per day, but will give close to maximum total output if its load is reduced to 100mA for the same time periods. Maximum efficiency is obtained at 25mA current drain, but if this is only for two hours per day, the cells starts to show signs of falling capacity due to ageing as well as use.

No electrical energy is produced by a cell or battery unless it is connected to an external circuit through which current can flow. However, from the minute cells are manufactured, secondary reactions and migration of chemicals result in loss of potential capacity. Normally, an unused cell or battery's minimum acceptable performance is taken to be 85% of its performance when

Load Current mA	Use per Day hours	Hours to on load output of 1V	Total milliamps x hours (mAh obtained)
300	2	8	2400
300	0.5	17	5100
100	4	38	3800
100	2	55	5500
25	4	255	6375
25	2	240	6000

Table 1: Shows the total energy output of a D-cell under differing conditions.



Cathode Cap (Positive Terminal)
Protrusion in contact with steel cell case.

Insulating Washer

Outer Steel Jacket
Lithographed in copper and black.

Separator
A sleeve of porous, synthetic fiber impregnated with electrolyte.

Anode
Powered zinc, highly amalgamated and compacted.

Electrolyte
Potassium hydroxide (KOH) solution absorbed into separator, anode material and cathode material.

Cathode
Compressed mix of electrolytic manganese dioxide (MnO_2) and graphite, introduced either by extrusion or by insertion in the form of pre-formed, tight-fitting cylindrical rings.

Cathode Collector
Steel cell case.

Plastic Sleeve
Separates steel case from outer steel jacket.

Anode Collector
Metal "nail."

Plastic Grommet
Forms a structural, insulating seal for cell.

Vent
Wax-sealed hole in plastic grommet (releases gases if they build up and prevents cell rupture).

Insulator
Separates (and insulates) steel cell case (positive) from the end cap (negative).

Anode Cap (Negative Terminal)
Protrusion in contact with collector "nail."

Alkaline Manganese Cell

Fig.5.

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brand new. The length of time for which the cell can be stored before it has deteriorated to this extent is called its shelf life.

The shelf life of zinc carbon cells varies according to size, storage temperature, etc. A typical AAA cell might show serious deterioration after only three or four months, whereas a larger D-cell might still meet minimum requirements after 9-10 months storage.

Heavy duty zinc carbon cells

Heavy duty zinc carbon cells are assembled in the same way as standard cells, but are intended to deliver higher currents for longer periods of time. The electrolyte solution normally incorporates zinc chloride only, which gives better electrochemical performance than the mixture of chemicals used in ordinary cells. It also has the advantage that the electrolyte and cathode become progressively drier during use, which reduces the likelihood of leakage if the cell is totally exhausted by excessive loads. Performance is also improved by the use of a higher quality blend of manganese dioxide in the cathode assembly.

Heavy duty cells give higher peak currents and have about 20% more capacity than ordinary zinc carbon cells of the same size but cost more because of the higher quality materials used. Their main applications are in large torches, portable cassette players and toys where periods of high drain could cause the rapid demise of standard cells.

Alkaline manganese cells

For many decades, the zinc carbon dry cell provided the only practical low cost source of portable power. During the 1940s American Samuel Ruben in association with the Mallory company (Duracell in Australia), developed the first practical alkaline manganese cell for consumer markets. These were first produced commercially in 1949 and have steadily grown in popularity, taking over from zinc carbon cells in many of the more demanding applications. They use some of the same basic ingredients as zinc carbon cells, but are totally different in construction and provide a far more rugged and durable source of packaged power.

Samuel Ruben's major innovation for cells of this kind was the use of the alkali potassium hydroxide in the electrolyte, which gives much better ionic conduction than acidic solutions. A highly conductive electrolyte means the cell has lower internal resistance, so the fall in output voltage with heavy loads is greatly reduced. In addition, potassium hydroxide does not undergo chemical changes during discharge, so the cell maintains its high current capability right to the end of its useful life. Another big advantage of alkali electrolytes is that they do not attack steel like the acids used in zinc carbon cells. This means that alkaline manganese cells can have strong, leakproof steel cases.

The internal structure of a typical alkaline manganese cell is shown in Fig.5. In many ways it is the exact opposite to that used for zinc carbon cells.

The anode, which no longer has to serve as the container, is made of powdered zinc combined with a little mercury. It is located in the centre of the cell and has a metal 'nail' passing through it to act as a current collector. This is in contact with a steel cap at the bottom of the cell, so the negative terminal is in the same place as it is on zinc carbon cells.

The cathode consists of a very pure form of artificially produced manganese dioxide, which has a greater oxygen content than natural ore, with graphite mixed in to aid conduction. This mixture is highly compressed, to further increase the oxygen content per unit volume and greatly improve the electrochemical capacity of the cell. The inner steel case acts as a current collector for the cathode and connects to a cap at the top of the cell which acts as the positive terminal. This is also in the same place as the positive terminal on a zinc carbon cell, making the two types readily interchangeable.

Anode and cathode are separated and prevented from short circuiting by a sleeve of porous synthetic fibre. Anode, cathode and separator are all heavily infused with the potassium hydroxide electrolyte to give maximum conductivity.

Higher load capacity

Off-load, alkaline manganese cells give the same 1.5V output as standard Leclanche type cells. With medium to heavy current drain however, the output voltage from zinc carbon cells frequently falls below 1V, whilst alkaline cells will usually maintain their output at 1.1 to 1.3V. All cells and batteries

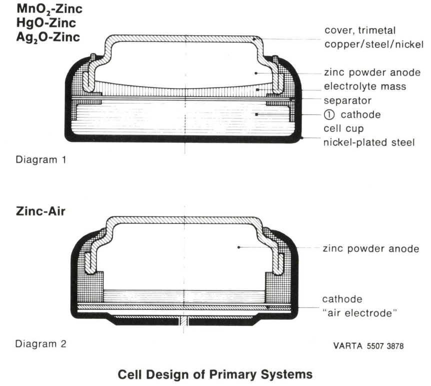

Fig.6a: Shows a mercury button cell and (6b) the zinc air cell. Courtesy of Varta.

show a fall-off in output at low temperatures, but manganese alkaline types hold up better than carbon zinc in this respect.

For high current applications, alkaline manganese cells can provide two to four times the total energy available from a zinc carbon cell of similar size. As a comparison, an ordinary zinc carbon D-cell might be rated at 4500mAh, a heavy duty zinc carbon D-cell at 6000mAh and a similar alkaline manganese cell at 10000mAh.

Alkaline cells generally also have better shelf-life characteristics than zinc carbon systems. Manufacturers' claims for their products vary enormously, but a good average figure would be two years at normal room temperatures.

Of course, the higher quality ingredients and more sophisticated construction of alkaline cells means they are more expensive to manufacture and buy. This higher cost may be justified if heavy current capability or long shelf life is important in a particular application. On the other hand, alkaline cells do not have the recuperative powers of zinc carbon cells when the circuit is switched off, so for some light-current intermittent use applications, the venerable zinc carbon cell could still prove to be a more cost effective source of power.

Button cells

The introduction of electronic watches, pocket calculators and miniaturised hearing aids, meant that a whole new range of small high energy cells had to be developed. Most of these have a flat circular shape and because of this, are known as button cells. Many use quite exotic electrochemical systems and we will take a look at some of these later. The construction of a typical button cell is shown in Fig.6a.

A small range of button cells using the alkaline manganese electrochemical system is available. Their main use is in photographic equipment where the peak current required to drive small motors, shutters and flash units exceeds the capabilities of other low cost systems. The good low temperature characteristics of alkaline manganese cells also make them particularly suited for use in cameras. One of the most popular button cells of this type is about the same diameter as a 10-cent coin and has a capacity of 300mAh.

Mercury and silver cells

We have already mentioned the part played by Samuel Ruben and the Mallory company in developing alkaline manganese cells. Before this significant advance however, they had already started a major revolution in primary cell technology, by developing and manufacturing the world's first practical mercury cells and batteries. These were produced just in time to be used in World War 2 military equipment, such as mine detectors and walkie-talkie radios.

The mercury cell uses mercuric oxide as the cathode material which, although expensive, packs much more oxygen in a given space than manganese dioxide. This is combined with potassium or sodium hydroxide as the electrolyte and powdered zinc as the anode. Open circuit output is only 1.35 volts, but this holds up very well under load until the cell is nearing the end of its useful life. Capacity per unit volume is good, with a typical mercury AA-size cell being rated at 2500mAh compared with 1700mAh for a similar alkaline manganese type.

The chemical symbols used to represent a zinc mercury oxide cell are $Zn\text{-}Hg0$.

The high energy density of the zinc mercuric oxide system makes it particularly suitable for miniature batteries and button cells. Fig.6a shows how a mercury button cell is constructed. Most mercury button cells are assembled in nickel-plated mild steel or stainless cans which do not take any part in the electrochemical reactions.

The highly compressed cathode fills the lower part of the can and is separated from the upper zinc anode section by an absorbent separator saturated with electrolyte. This method of construction is common to most types of button cell regardless of the electrochemical system being used and results in the lower can being the positive terminal and the top being the negative terminal.

One disadvantage of mercuric oxide as a cathode material is the rather low 1.35V output it provides, but this can be beefed up to 1.4V by adding a little manganese dioxide. The price that has to be paid for this extra 0.05V is a significant reduction in shelf life however, so it hardly seems to be worthwhile.

Silver oxide cells

First generation solid-state electronic equipment using germanium devices could be made to work quite well with a 1.35V supply and so mercury button cells found widespread use in transistorised hearing aids. Silicon ICs need a slightly higher voltage and this has resulted in a second generation of button cells using zinc silver oxide cathodes becoming available.

Silver oxide is even more expensive than mercury oxide but raises the cell's open circuit voltage to about 1.6V. Construction is the same as for mercury cells (see Fig.6a), excellent constant voltage discharge characteristics are obtained and a shelf life of two to four years is possible under favourable storage conditions.

The energy density of silver oxide is slightly greater than mercuric oxide, but as some of this energy goes towards giving a higher output voltage, the actual current rating figures in mAh for similar sized cells or batteries can sometimes be a little less. The chemical symbols for zinc silver oxide cells are $Zn\text{-}Ag_20$ or $Zn\text{-}Ag_20_2$ depending on the type of silver oxide used.

Mercury batteries work well at normal and high temperatures but are not recommended for use below 0°C. Silver cells and batteries have fairly good low temperature performance however, and will give 70% of their maximum output at 0°C.

Despite their higher cost, the superior characteristics of silver oxide button cells have made them the preferred type for use in watches, miniature calculators, and so on.

Mercury reference cells

Long before practical commercial mercury batteries were developed, experimenters were aware of the very stable voltages provided by this cathode material (Fig.7). In 1872 Clark produced a mercury zinc cell giving a standard output of 1.434V and later, in 1892, Weston developed an even more stable mercury cadmium cell, giving 1.0183V. Neither cell was of use as a practical source of electrical power, but both types served as laboratory voltage references until quite recently.

Zinc-air cells

The air we breath contains about 20% oxygen and it seems logical to use this abundant supply to oxidise the anode in a cell instead of depending on the rather restricted quantity available from the cathode material. Work on fuel cells for the Apollo moon landing program greatly advanced our knowledge of the electrochemical processes involved and led to the development and recent commercial introduction of zinc-air cells.

Although the concept is very simple,

the complications posed by exposing chemically active sections of the cell to the wide variety of gasses and impurities in the atmosphere created quite a few problems. In button cells, which might be used in any position, it also proved difficult to let sufficient air in without allowing electrolyte to escape. The construction of a typical zinc air button cell is shown in Fig.6b.

If air is prevented from reaching the active parts of the cell, it will remain dormant and have a very good shelf life. During manufacture, the cell is sealed with plastic or foil over the air access holes. When the cell is required for use, the seal is pulled off, to let in air and start the cell working. It will then continue working and cannot be put aside for a time and re-used later, like a normal chemical cell. This means zinc air cells are well suited to applications such as hearing aids and electric fences, where power is required continuously from the time the battery is installed until it is exhausted.

The total energy available from a zinc air cell is somewhat more than from a similar mercury or silver cell in terms of volume and a great deal more in terms of weight. As an example we can compare physically identical mercury and zinc air button cells, designed for hearing aid use, from the Varta company's range. Both cells give 1.4V off-load but the mercury cell has a capacity of 250mAh and weighs in at 2.6 grams while the zinc air cell has a capacity of 400mAh and a weight of only 1.7 grams. As no exotic materials are involved in their construction, zinc air-cells also promise to be a fairly economic source of power. Their off-load output of 1.4V falls only slightly during use, as shown in Fig.7.

Construction details of a large zinc-air cell are shown in Fig.8. The cathode assembly comprises a porous carbon material which acts as the current collector in the same way as carbon particles in ordinary Leclanche type cathodes. An alkaline electrolyte, such as potasium hydroxide is normally used although zinc cells using acid electrolytes have also been developed.

Lithium systems

At the beginning of this article we said that a good anode material should have a strong affinity for oxygen. For many years, scientists have known that of all metals, lithium would make the most electrically efficient anode because of its extreme reactivity to oxygen. The irony was, that this same reactivity made it necessary to keep the metal out of contact with oxygen in either air or water vapour, thus making it very difficult to handle on a factory production line. It is only in the last few years that new techniques have been developed to permit the design and manufacture of lithium anode cells on a commercial basis.

Lithium is only number three in the table of atomic weights for the 92 naturally occurring elements. The gases hydrogen and helium are numbers one and two respectively, so it is no surprise to find that lithium is easily the lightest of all metals. Its galvanic voltage is −3.045V which means that an associated cathode need only make a modest positive contribution to give a total open-circuit cell output approaching 4 volts, more than twice that of all other developed primary systems.

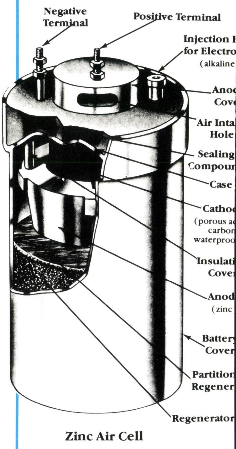

Fig.8: The large zinc-air cell is well suited to continuous power needs.

Another area where lithium cells easily outperform other types is their exceptionally good shelf-life. Surprisingly, this comes about as a result of lithium's extreme reactivity, which we might reasonably assume would keep the cell's chemistry simmering away. What actu-

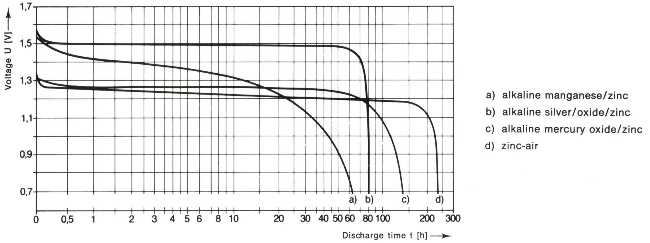

Fig.7: Typical discharge curves of different cell systems. Diagram courtesy of Varta.

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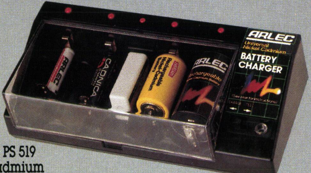

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ally happens is that, as the electrolyte is introduced to the cell during manufacture, an immediate reaction occurs, creating a thin passivation layer on the anode. This layer insulates the anode and completely stops all further chemical action until the cell is put into use.

If the cell is operated at low discharge currents, lithium ions formed on the anode surface can migrate through the passivation layer, without disturbing its ionic lattice structure, so the cell's low self-discharge performance is maintained. When higher currents are demanded however, the passivation layer breaks up, reducing internal resistance and enabling the cell to deliver the current required. Under high load conditions, some lithium cells show a lag in performance, with the output voltage dropping initially for a few seconds until the internal resistance adjusts to the current required.

The voltage nature of lithium means that a little more care is needed when handling and operating cells containing the material. Lithium melts at just over 180°C and if the anode exceeds this temperature, it will flow and react with other materials. This may further increase the temperature, resulting in a runaway reaction causing the cell to vent or explode. In either case, toxic and corrosive gases can be released, so it is important to avoid all situations which might cause cell overheating. These include high external temperatures, short circuits, attempts at recharging or reverse voltages being accidently applied. Some larger cells and batteries have built in fuse links to protect against excessive current flow and most manufacturers advise against using a soldering iron to make connections directly to cell cases.

Types of lithium cell

Manufacturers catalogs now offer an almost bewildering array of lithium cells but we will categorise them into three basic groups and describe one or two examples of each type. These three groups are cells constructed in the 'conventional' way with solid anodes and cathodes plus a liquid electrolyte, cells using a solid anode but a combined liquid electrolyte-cathode material and finally, some very special devices with solid electrolytes.

One of the earliest cells to be developed uses well tried and tested manganese dioxide for the cathode, but with lithium replacing zinc for the anode. Chemical shorthand for this system is Li-MnO_2. We mentioned earlier that lithium reacts violently with the oxygen in water, so the traditional acidic or alkaline electrolyte solutions cannot be used. In lithium-manganese dioxide batteries, the electrolyte is usually a conductive organic liquid having good chemical stability.

Two different cathode structures are used, a pressed powder disc type for low current button cells and a thin grid coated with manganese dioxide paste for high current rectangular and cylindrical cells. The construction of button and cylindrical Li-MnO_2 cells is shown in Fig.9.

Several Japanese companies have been very active in the development of lithium technology. One popular system resulting from this work uses a cathode material called poly-carbonmonofluoride. The chemical shorthand for batteries of this type being Li-(CF)n.

A white fluorocarbon cathode material is produced by chemically combining carbon powder and fluoride gas. This is mixed with acetylene black to improve its conductivity and act as a binding agent, before being pressed into the required cathode shape. The anode is made from thin lithium sheet which has a nickel or stainless steel connection pressure welded on to carry current to the cell's external negative connection.

The electrolyte is based on an organic solvent which has alkali metal salts added to make it electrically conductive. A porous separator, made from polypropylene fibres and impregnated with electrolyte, keeps the anode and cathode apart.

Poly-carbonmonofluoride cells are finding their way into some consumer applications and emphasis has been placed on safety in their design. For example, the cathode material will not decompose at temperatures below 400°C. The organic electrolyte has a boiling point above 200°C and both cathode and electrolyte are non-toxic and non-corrosive. Construction methods are similar to those for the lithium manganese cells shown in Fig.9. Cylindrical batteries are assembled in strong nickel-plated steel cans and button cells are encased in stainless steel.

Both Li-MnO_2 and Li(CF)n cells have open-circuit outputs of over 3.0V and working levels of about 2.8V at light to medium loads. The manganese units operate from −20°C to +50°C, which should meet most requirements, but the fluorocarbon types have a range of −40°C to +85°C. It is difficult to compare the capacities of different systems due to variations in cell size, voltages and discharge rates, but total stored energy for both types of lithium cell described above is about three times greater than for similar alkaline manganese cells. Shelf life is quoted at six years to 85% capacity for lithium manganese cells and a loss of 0.5% per annum, or about 10 years, for the fluorocarbon types.

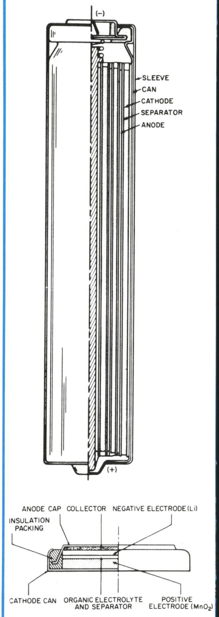

Fig.9: Button and cylindrical lithium manganese dioxide cells.

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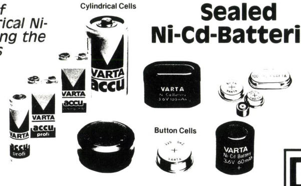

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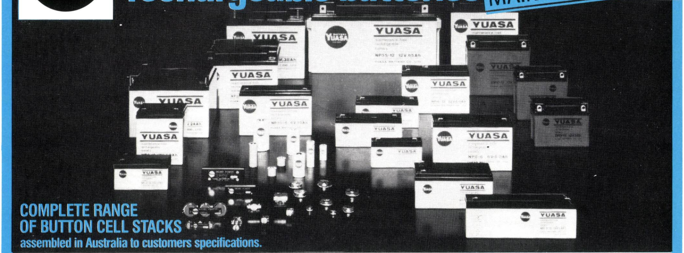

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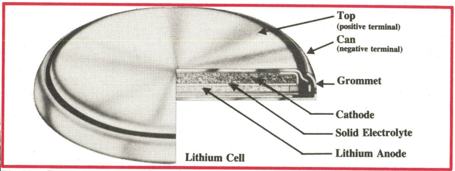


Fig.11a: Shows the construction of a typical lithium iodide cell. Courtesy of Duracell.

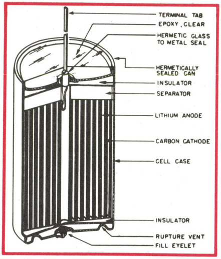


Fig.10: The lithium sulfur dioxide cell. Diagram courtesy of Duracell.

ithium liquid cathode cells

The second group of lithium cells use a liquid which combines the functions of lectrolyte and cathode.

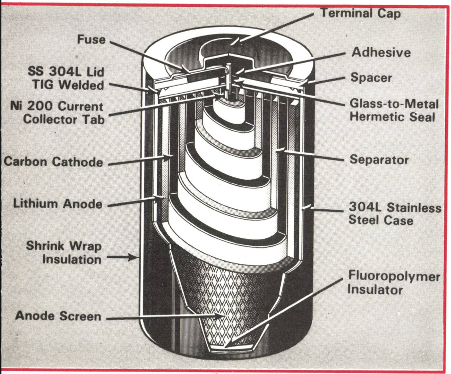
The first system of this type to be-come popular combined lithium and ulphur dioxide (Li-SO_2). This range of ells has most of the favourable features ssociated with lithium manganese cells ut they are better suited for applica-ions requiring high discharge currents.

The cathode collector is usually a fine luminium grid coated with a teflon-arbon black mixture. This provides the arge surface area and low resistance ecessary for high current operation. he anode consists of a length of ithium foil and a microporous poly-ropylene separator which prevents it oming into contact with the cathode rids. Each cell is assembled in a hermetically sealed steel can and the sulphur dioxide electrolyte is inserted through a hole in the bottom, which is later welded close. See Fig.10.

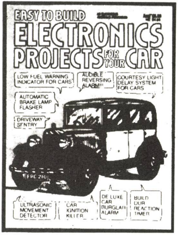
Users of these cells are advised to include fuses in external circuits to prevent excessive discharge current, not to connect cells in parallel, which can lead to one cell charging another and to avoid discharging cells to below 2 volts.

Today's highest performing liquid cathode system and one which is often called the work horse of the range, uses a lithium-thionyl chloride combination (LiSOCl_2). An open-circuit output of 3.65V is obtained and this falls to between 3.5 and 3.0 volts according to load with excellent stability, until the cell is nearing exhaustion.

The higher output voltage of thionyl chloride cells increases the total watt hours of energy stored by 20 to 25% compared to sulphur dioxide types. Self discharge is low, giving a shelf life of at least 5 years. Normal operating temperature range is from −55 to +70°C but special types are available for use up to 150°C. Some of the latest designs have electrolytes formulated to overcome initial voltage drop problems caused by the anode passivation effects mentioned earlier. Many smaller cells of



ig.11b: The lithium thionyl chloride cell is for low drain 'fit and forget' applications.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Cells and batteries

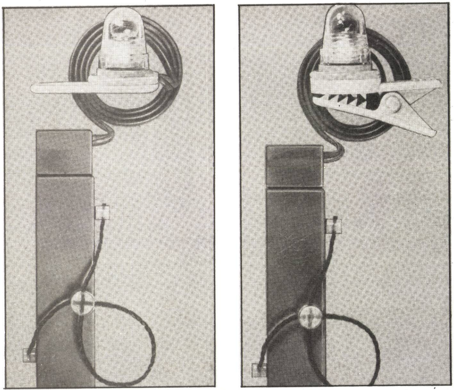


Fig.12: Above is the sea water battery which is manufactured without an electrolyte.

this type are also now designed to withstand short circuiting without risk of explosion.

Thionyl chloride cells can be constructed in a variety of ways, but the normal method uses a lithium foil anode and a carbon coated mesh cathode rolled up in a hermetically sealed can, similar to those for lithium sulphur dioxide cells shown in Fig.10.

Applications for solid and liquid cathode lithium batteries are many and varied. They have some clear advantages over other types which include maximum available voltage output per cell, very high current capability, lightweight, exceptional shelf life, operation in extremes of temperature and high stored energy per unit volume. On the negative side however, some care is needed to ensure they are handled, used and disposed of in a correct and safe way. As a result, most manufacturers prefer to restrict their use to 'technical' customers rather than to make them freely available to the general public.

Solid electrolyte types

In most cells, the electrolyte's main function is to provide a path for ions to move between cathode and anode without also short circuiting the two electrodes. There are a number of solid materials, such as salts and ceramics, which have high electrical resistance, but also contain mobile ions of one particular type. By combining one of these materials with an anode and cathode which use the same type of ion in electrochemical activity, it is possible to make an all solid-state cell.

Commercially available cells use lithium anodes, lithium iodine electrolytes and a variety of chemically complex cathodes. At room temperature (20°C), outputs of about 1.9V per cel with load currents of between 15 and 30 microamps are obtained. The working temperature range is −40°C to 120°C with current capability increasing a cells warm up, as this improves th mobility of the ions in the solid electrolyte. At 95°C the current capability i 10-20 times the room temperature figures given above, but at −40°C it i down to only a few percent of room temperature levels. The construction o a typical all solid cell is shown in Fig.11

Solid electrolyte lithium iodide cell have excellent shelf-life with figures o 20 or more years being quoted. There i no possibility of gassing, leakage or corrosion, even under conditions of sever misuse. The amount of stored energy i very high and as this can only be take from the cell at a slow rate, due to th low current capability at normal temperatures, the service life can easily extend to 10 years or more.

Typical low drain 'fit and forget' applications for solid electrolyte batterie include heart pacemakers, LCD watche and CMOS memory power back u systems.

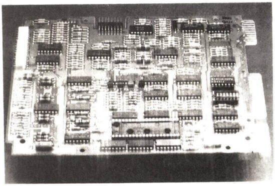
Sea water batteries

One of the more unusual groups c batteries is manufactured without an electrolyte at all. Their best known us is to power lights on life jackets or lif rafts during emergencies at sea. A system of this type is illustrated in Fig.12.

The battery consists of silver chlorid or copper chloride and magnesiu plates inside a moulded polythene cas To activate the cell, sealing plugs ar removed from the top and bottom c the case which is then immersed, allowing sea water to flow in and act as a electrolyte. The cell shown will giv 1.5V output at 0.11A for 20 hours. Th is sufficient to light a small lamp to ai location of the unfortunate user.

Cells of this type have an indefinit shelf life as long as they remain sealed Once activated however, no matter fo how short a period, they must be considered expended.

(Next month we will conclude our surv with secondary cells and batteries.)



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"RADAR DETECTORS" Which is the best?

"We pitted the Bandits' against the Whistlers'"
"One make came out clear leader"

The radar detector industry has had its ups and downs. Recently a couple of makes have clashed in a savage marketing battle. Advertising claiming this particular detector is the best in the world appears. At the same time another detector is being proclaimed champ of the highways. Marketing ploys do not interest Truckin' Life all that much, but readers were becoming confused. Phones were running hot with operators asking what is going on? Which detector is best? Do any of them work properly? We rallied to the cause, and ran a small independent test west of Sydney using the two most popular forms of police radar. We pitted the Bandits against the Whistlers. One make came out clear leader. Bruce Honeywell survived the shootout and reports . . .

IT was high noon on a long stretch of road west of Sydney, somewhere with the unlikely name of the Cowpastures which happens to be the place the cattle brought with the First Fleet were found after they made a break for freedom. With the sun high overhead it was time for a shootout.

But there was no crash of pistols, no ricocheting of bullets gone wrong. Instead, a Canter truck trundled back and forth, doing the eight kilometre round trip time and time again. It was the scene for a shootout comparison of four radar detectors.

The radar detector industry has had gold rush boom periods in the past, and in the following slumps many importers went to the wall. Big bucks have been made and lost. The present market barometer shows that another boom is coming.

There are several makes of radar detector for sale in this country, and as police speed detecting equipment becomes more sophisticated, so do detectors. The superheterodyne sets of today using modern 'chip' technology are a far cry from those early models.

The pages of *Truckin' Life* and other newspapers and magazines have become something of a battlefield for two makes of radar detector. The Whistler products and Uniden's Bandit line have been making claims and counter claims about their respective efficiencies and how good each make is.

This is understandable, as the Australian free market system lets the gladiators battle it out to the finish. But inquiries at *Truckin' Life* have shown that the advertising campaigns were confusing truck drivers, not at all sure which way to go.

We certainly have not been backing any particular horse in the dispute, but with more and more confused drivers ringing our office each day, it was decided something had to be done. So a test of the Unidens and Whistlers was set up.

Validity is essential in any test, and particularly so with radar detectors. A detector can be 'twigged' up to make it extremely sensitive. Of course that sensitivity might make it completely useless for normal operation by being able to pick up a Kentucky Fried Chicken shop at five kilometres. The unit's life would also be drastically reduced.

So we had to find a way to get round coming out and asking the manufacturers or importers for models for a test. There is usually a selection of radar detectors lying around *Truckin' Life* undergoing general tests. I dug up a Whistler Q3000 I have been using for over 12 months. It had done a lot of the tests with me, and had been through WA, the Territory and Northern Queensland. It had been in different trucks and had been knocked around a bit. I dug it out of an old box, blew the bull dust out of it and I had contender one for the shootout.

I had a Whistler Q2000 in my Pajero, for my own use. I have had it for about eight months and it was working — contender number two. That completed the Whistler side of the contest.

I had placed a Uniden Bandit 55 with a mate running out to Roma, so I caught up with him and pulled it out of his truck. It was working and it had been around for over eight months — contender three was looked after.

The only other detector I needed for this two brand shoot out was a Uniden Bandit RD9. I didn't have one. I contacted Greg Welsh of Speed Safe, an independent retail outlet and radar specialist in Sydney, and said I needed a radar for a test. He told me he had 'them all' and I could pick whatever I wanted off the shelf.

So the radar detectors were organised. Now something to test them with. The RACQ in Queensland provided its own Speed Gun, a hand held X band radar gun. I approached Pat Mulligan of Creative Electronics — I had heard he owned a KR-11 radar set, the dreaded mobile radar unit of the NSW police. He did and was only too pleased to lend it for the test.

All that remained to be done was to do it.

The Contenders

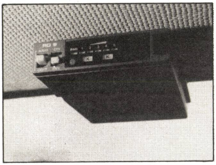
1. UNIDEN BANDIT 55: The Bandit was the flagship of the Uniden squadron until the pocket-sized RD9 came along. The Bandit 55 is 13cm long and wide, and 4cm deep. It can be attached to the sun visor or the dash. This superhet detector is fitted with a volume control, a bright/dim switch for the indicator lights and a switch for either highway or city use. The city switch is designed to cut down interference in urban areas.

   A series of LED's tell the driver that the unit is working, and the strength of any incoming signal. A large red warning light tells of the incoming radar.

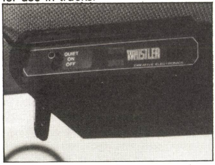
2. UNIDEN BANDIT RD9: This detector was by far the smallest of those tested, only 10cm long and 5cm wide and a little over a centimetre deep. Controls are similar to the larger Bandit 55, with a volume/on/off control, a selection switch that allows audio warning signals, visual warning signals or both, a series of LEDs that

show the strength of the incoming signal. Light indicators show if the incoming signals are either X band or K band radar. As with the 55, there is a city or highway mode switch.

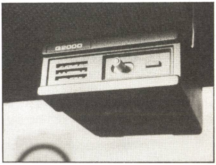
The RD9 has an automatic photoelectric sensor that adjusts the brightness of the control panel to suit the light conditions of the cab.



3. WHISTLER Q3000: The Whistler Q3000 is a larger detector than the RD9, roughly the same size as the Bandit 55. It is a double superheterodyne with a scanning frequency discriminator and operates on the K Band and X Band. The alert signal is a pair of flashing red lights and a loud beeping whistle. There is a one switch operation to three positions — off, on and quiet (for urban areas). The Q3000 is a solid, robust set manufactured in Australia with US componentry and is designed especially for use in trucks.



4. WHISTLER Q2000: The 2000 is smaller than the 3000, and is not designed especially to withstand the vibration of trucks. It operates on similar K and X bands as the 3000 and has similar features. It has a built in one piece visor clip.



The Test

The detectors were put through a series of four tests. The first was with the KR11 mobile radar of NSW. It was set over a four kilometre stretch of straight road with three rises and one dip.

The stretch of road is symbolised in each test run in Fig 1.

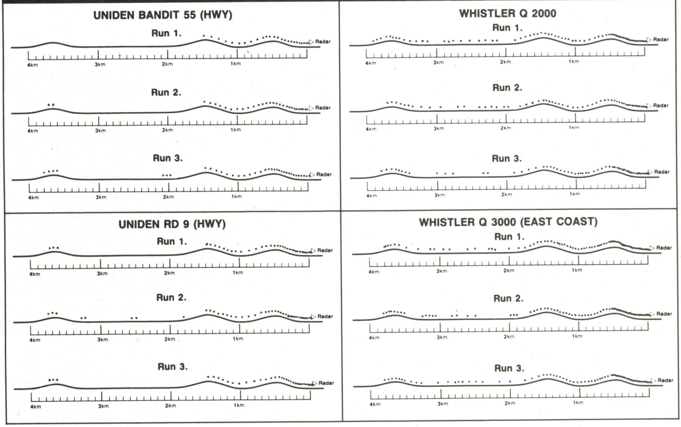
The radars were selected at random for each run, and each one was run through three times so that an average could be worked out. The results can best be seen in Fig 1, where each dot denotes a reaction from the detector.

BANDIT 55: This was the poorest result from the four, with one run returning no reaction until 1.4km from the radar set. The other runs got a slight reaction at the first rise 3.7km from the radar.

BANDIT RD9: The little detector returned a reasonable performance with a strong reaction at the 3.7km rise, and

Continued next page

FIGURE 1: KR11 MOBILE RADAR K BAND (HIGHWAY MODES)



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a couple of scattered reactions on one run at 3.3km, 2.5km and 1.7km. Strong reactions were received from the top of the second rise at 2.4km and continued through the dip all the way to the radar set.

WHISTLER Q3000: The 3000 reacted strongly before the first rise (3.7km) and continued on all runs with reactions every 50 metres or so through to the 2.4km rise, and strong loud screaming from there to the radar set.

WHISTLER Q 2000: The little set was, if anything, more sensitive than the 3000. On one occasion it picked up the beam well before the first rise, and it continued on all runs right through the full course.

Fig 1 shows the reactions of the different detectors. The Whistlers gave loud and raucous warnings, compared with the more muted tones of the Bandits. While the Bandits had LED wizardry to denote signal strength, there is little time to look at these when you are hitting the jake and dropping a cog or two in panic.

★ TEST 2: The second test was a simple one run shootout between the RD9 and the Q3000 to establish any difference in city modes. The RD9 was set on 'city', the Q3000 was set on 'quiet.' As can be seen in Fig 2, the RD9 did not react until line of sight was reached with the radar detector — about 320 metres.

The Q3000 operated as normal, the 'quiet' mode just reducing the volume of the little screamer.*

TEST 3: This test involved the use of the X band radar speed gun. It was set up on a tripod and aimed along the road, and left that way so that the direction of its beam was exactly the same for all runs.

Fig 3 shows the reactions of the different radars, with the Q2000 again coming out on top, matched closely by the Q3000. The Unidens were substantially behind in this test.

It is to be noted that Whistler put out two versions of the Q3000, an East Coast and a West Coast. The West Coast has X band tuned up as this is the main radar band used in Western Australia. The Q3000 tested was an East Coast version. Therefore, better X band results could be expected with the West Coast version.

TEST4: The fourth test was back to the K band KR11 mobile radar. It was a 'going away' test, an indication of how sensitive the detectors are to a mobile radar coming up behind. This method of speed detection is used widely in NSW where a police officer can lock in on the speed of a vehicle ahead of him, and pace him in the dark.

Fig 4. shows the results, with the Bandit RD9 cutting out at about 510 metres, the Bandit 55 cutting out at 600 metres. The Q3000 cut out at 1.3 kilometres, and the sensitive Q2000 did not cut out until past 2.4 kilometres.

CONCLUSIONS: All radar detectors tested have a good name on the highway, and all have their good points. The Q2000 clearly leads the way in sensitivity. The Q3000 is especially designed for high vibration, rough and tough use in trucks.

The Whistler products have a high quality control standard, and have a high Australian labour input. The Unidens are professionally made imported models that are earning a good name for themselves in the States.

Retail prices at time of going to press were:

Whistler Q2000	$399
Whistler Q3000	$499
Bandit 55	$399
Bandit RD9	$499

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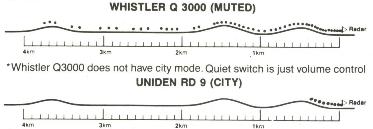
FIGURE 2 KR 11 MOBILE RADAR — K BAND (CITY MODES)



*Whistler Q3000 does not have city mode. Quiet switch is just volume control

★ This test is not of like controls. Quiet mode on Whistler Q3000 relates to volume whereas city mode on Uniden is designed to suppress city false alarms.

FIGURE 3 SPEED GUN 1 — X BAND

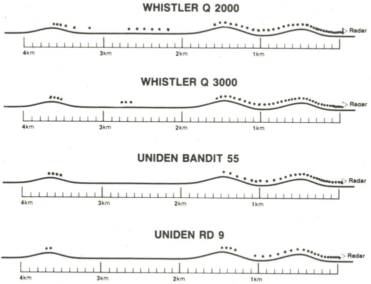
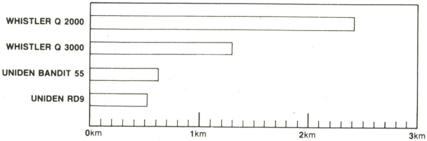


FIGURE 4 "GOING AWAY" TEST — KR11 MOBILE RADAR



A practical approach to Electronics 11

How to service record players

Last month, we concentrated on turntable drive mechanisms. In this, the final chapter of the series, we take a look at common tonearm and cartridge problems.

by KINGSLEY HOWE

Tonearm problems

As with multiplay record decks, a tonearm lifter is employed in manual decks to raise the stylus clear of the record surface when the arm is returning to its rest.

Two basic types are in use. One consists of a plain metal pin with a plastic or rubber cap. The other type is generally moulded from plastic in the form of a post with a wing (curved guide) on top. These may be termed as: (1) Plain Post Lifters; and (2) Winged Post Lifters. Both work in similar ways.

When the main gear begins to turn, a cam follower operates linkages below the deck. These raise the tonearm from the record surface, and then return the arm to its rest. In the latter position, a microswitch opens to cut power to the deck motor.

However, this does not always happen as described. The tonearm may lift but not return; move part of the way only; shudder or jerk; or drop clear of the rest post and land on the deck base. Sometimes, the tonearm will settle on the rest, then jump off, just before the platter stops.

On occasions, the tonearm may pause for several seconds after lifting, then make a wild swing across the deck.

The metal post lifter

The lifter is retained by a plastic or metal bush fixed to the deck baseplate. The upper part is tipped with soft plastic or rubber. This is in the form of a plug with a head and shank. The head is the only part visible. The shank is pushed into a hollow in the lifter to retain the plug.

When the lifter rises, it contacts a metal wing attached to the tonearm. This provides support whilst the tonearm is in motion. Screws located under the tonearm hold the wing firmly in place. Sometimes these work loose, allowing the metal wing to tilt upwards at one end.

Depending on the degree of tilt, the tonearm will either drag the stylus across the record surface, or fall off the edge of the platter and on to the deck plate. The arm will then continue moving until it contacts the base of the armrest. At this point the return mechanism tries to push it further.

Pressure is then exerted on the locking screws at the lower end of the tonearm pivot plate below deck, which then throws the setting out of position. When attempting to play another record, landing and lifting positions may vary from normal by several centimetres. The tonearm must be lifted and the wing screws tightened before any adjustments are made.

Sometimes the thread is found to be stripped, and unable to be tightened. Using a larger screw is not advisable, as the light aluminium tube may split or develop a bend. Attempts to straighten the bend can easily fracture the tube.

If the above problem is encounterec
remove the wing, apply a good contac
adhesive to both surfaces and assembl
whilst wet. Apply some to the screws
and fit these also. Although these ma
be loose, this is the only way that co
rect alignment can be obtained.

Once this assembly has taken place
return the tonearm to its rest, an
clamp it with the transport clip. Som
thin packing may be inserted betwee
the wing and the lifter post to provid
support whilst the adhesive dries.

Alternatively, an adjustable 'jac
may be used instead. This consists of
12mm bolt and nut. Place the head c
the bolt squarely on the deck plate, an
simply turn the nut until the correc
height is reached, then slide the nu
under the end of the wing. The metho
used may vary from deck to deck, de
pending on space available. Check tha
the wing is parallel to the platte
surface.

Note that any adhesive found on th
polished aluminium arm must be re
moved whilst still wet. If allowed t
dry, attempts at removal will leave ur
sightly scratches. Use a cotton bud c
cloth dampened with mineral turps.

Caution: use as little as possible
Turps running on to the joint area wi
inhibit or prevent curing.

Jumpy or incomplete returr

The main culprit for the above anti
is the tip at the top of the lifter. Thes
are prone to deteriorate with age, an
become soft and sticky. The consistenc
is similar to that of road tar.

Some of this compound adheres t
the underside of the metal wing, causin
extremely high friction. Use of a sma
mirror to examine the underside
about the only means of detection. Re
moval is effected by the use of minera
turps.

On some decks, the tip may have been oiled by the owner. This application of oil will only cause the condition to worsen. The best approach is to remove the tip and clean out the centre hole with a small diameter drill. The tip may be replaced with a small dome-head screw or a nickel plated rivet. The latter is preferred, as the head is smooth, and there is no difference to normal operation.

Note that the deck must be tested for correct loading of the stylus. Any departure from the normal landing position (3mm in from the edge of the record) indicates slippage of the locking screws on the tonearm pivot plate, or bending of the linkage between the tonearm pivot plate and the main gear cam follower.

Winged post lifters

Most winged post lifters are made from plastic, although some contain a rubber insert. When returning across the deck, the tonearm slides on the flat section until the rest is reached. At this point, a cutaway in the end of the wing allows the tonearm to drop into the cradle.

The lifter then retracts into the deck, eaving the arm resting safely. Sometimes the tonearm will reach the rest, and then jump off before the deck stops.

If the arm parks in the cradle, it can be safely assumed that the deck linkage adjustments are not at fault. The main problem appears to be caused by the onearm riding on the flat part of the ifter. It may reach the end, near the cutaway, but not drop into it completey. The arm then kicks back, due to mall movements of the deck linkages, ust prior to shutdown.

To correct this problem, enlarge the cutaway by removing several millimetres of the flat section with sharp knife. Start with one or two millimetres at irst, and only remove more if required.

Keep the cutout corner fairly sharp square) to arrest any kick back. After his modification, the tonearm should drop squarely into the cradle. It may ive a slight jerk, but should remain in lace.

Sometimes, the rubber insert may be missing. This may be replaced by a mall piece of black cable insulation with the wire removed. Apply a coating f adhesive to the lifter, then fit the lastic piece to it. Use narrow strips of masking tape to hold it in position. When the glue has set, paint the area with tyre black to enhance appearance.

Resetting the tonearm

The locking screws mentioned above may be loosened, and the arm repositioned. Clip the tonearm to its rest before any alterations are made. Bear in mind that the ratio of the tonearm pivot plate to the tonearm length can vary from 5:1 to 20:1. Any slight movement of the plate will thus be multiplied greatly.

If the tonearm has been subjected to any strain, check the upper swivel assembly (found near the counterweight) for play. To do this, grasp the headshell and rock the tonearm from side to side. The swivel pin may be loose or bent. Some of the cheaper models cannot be adjusted, as the pin is simply inserted through a plastic housing.

Better quality decks are fitted with tapered metal bushes and locking nuts. If the tonearm feels sloppy, release the locknuts and turn the threaded bush slightly clockwise to tighten. Over tightening may bend the swivel pin, or prevent the tonearm from lifting high enough.

Whenever any alteration of this type is made, check the stylus for correct attitude. Load the stylus onto a stationary record and sight the stylus directly from the front of the cartridge. It must sit vertically. Any tilt or slant of the stylus will throw a heavy load on one wall of the microgroove. As the stylus pressure is around several tonnes to the square centimetre, and its running temperature is normally three times that of boiling water, any slight error will have drastic results.

One wall usually wears at the top, and the opposite wall wears at the bottom. Once this happens, the stylus side movement is severely restricted and the reproduced sound exhibits distorted treble and low volume.

With the stylus dead vertical, the pressure is shared equally by both walls. The running temperature is still the same, but under these circumstances, the record surface melts and reforms to its original shape.

Tonearm linkage adjustment

With most record decks, the linkage between the cam follower and the tonearm swivel plate is not adjustable in the usual sense. No screws or movable parts are to be found on it.

Some types are deliberately offset with two bends in the centre forming a 'Z' shape. It is common practice on assembly lines to make the linkage shorter or longer, by gripping the mid-section of the 'Z' with a heavy pair of pliers and altering the angle. This is done to ensure that the automatic trip operates at the end of play, when the stylus is close to the last runout groove.

On decks where the tonearm loads and unloads automatically, alteration of the landing position may cause either premature lift-off or none at all. Where no independent adjustments are possible, a compromise must be reached to satisfy both conditions. Otherwise, the landing and lift-off positions may be altered independently.

Premature lift-off (last track on record not played completely) may be found on a few records where the recorded track is closer to the spindle hole than the industry standard. This problem was around for many years before a conference between the deck manufacturers and the record companies agreed to set a specific distance from the centre of the disc as a cut-off point for recording. Peace reigned for several decades after this, as all records then played right through and the trips functioned at the correct setting.

However, an occasional recording will be found to be non-standard. Setting the trip to play these through fully will cause the standard record to fail to operate the trip. On some models, a compromise can be reached. This is dependent on the date of manufacture of the turntable, and the standard prevailing at that time.

Partial lift or no lift

The lifter pin is raised by a metal plate beneath the deck. The plate is often bent at an angle, and more or less lift may be obtained by altering the angle using long nosed pliers.

Others are set by a screw and nut combination, fitted to the top of the pin.

Always check that the pin is not bent

Servicing record players

and jamming in the guide bush. The tonearm should clear the side of the rest before lowering into the cradle. If it does not, then more height is required. A small piece of metal, such as a screwhead, may be glued to the top of the pin, if there are no adjustments. In some cases, a screw and nut may be employed where space permits, for fine adjustment. A portion of the pin may need to be filed off to permit this.

Skating and/or no sound (magnetic)

The diamond tip in this type of cartridge is very tiny. When the tracking weight is found to be correct, and the tonearm skates, the tip may be missing. Remove the stylus holder from the cartridge and examine it with a magnifier. A small black jewel may be seen mounted near the end of the cantilever. If a tiny hole is evident, you may safely assume that a replacement is needed.

Sometimes a collar of hard material forms around the tip, and this may not allow it to sit properly in the groove. The collar is formed by dust and particles of vinyl worn from the record.

As the collar becomes wider, more material is trapped beneath it. This has a 'jacking' effect as the buildup increases, until the stylus may lift right out of the groove. The coating may be removed with stylus cleaner liquid and a soft brush, available from hifi stores.

Replacing the stylus

Before playing any records after the stylus has been replaced, check each record surface for scratches or deep pits. A pit on the surface of a record will result if the tonearm is allowed to fall on it. The diamond then digs in to form a small pit with steep sides, particularly when the record is stationary. When the diamond encounters this, or a deep scratch, while playing, the sudden impact can pull the tiny jewel out of its mounting.

If you have suffered the loss of a tip, and have just replaced the stylus, check the record very carefully. Otherwise the new stylus may last only a few minutes, suffering the same fate as before.

Tracking weight

Magnetic cartridges require a much lighter tracking weight than ceramic types. Excess weight will force the cantilever up into the cartridge and cause skating. The cantilever may also develop a permanent bend, which will lift the diamond clear of the surface.

All magnetic styli are colour coded. The replacement must not only fit the cartridge properly, but be of the correct colour as well. Some are interchangeable, if the substitute is selected with care.

Unlike the ceramic cartridge, a magnetic cartridge has no rubber yoke to support the cantilever. The cantilever in the stylus holder is mounted on a miniature pivot; tension is applied internally according to the tracking weight.

When the correct conditions are met, the magnet inside the protective tube will assume a central position, clear of the tube walls. This allows the magnet to faithfully follow any motions of the stylus and generate a clear signal. With the incorrect selection of a tracking weight, the magnet may come into contact with the tube walls, or assume a position such that the magnet is not equidistant with respect to the two pickup coils inside the cartridge. Thus, when substitutions are made for the original stylus, tracking weight must be altered to suit.

Correct weight

The correct weight setting may be obtained by the use of a tonearm balance sold by hifi stores. If the tonearm is calibrated in grams, the tonearm may be brought to a zero weight condition by moving the weight backwards, until the whole assembly assumes a horizontal position. The tracking weight may then be selected by moving the weight forwards by the appropriate number of graduations.

Loss of signal

Loss of signal from the cartridge i also covered in the ceramic cartridge section. Note, however, that the outpu from magnetic cartridges is far smaller and any corrosion on the contacts o plug-in headshells or slide-on pi connections will completely block the signal.

The contacts may be cleaned with soft brass brush. These are not to b confused with steel wire brushes. Th wires on the steel brush are too stiff and may well remove any protectiv electroplated coating.

The main purpose of the brass brus is to remove any oxides from the pins Steel wool does not reach into all th corners, and only cleans the outside o the pins. Clean off any remaining dus or grease with solvent or methylate spirits. With the latter, dry as soon a possible, as this chemical contains minor amount of water.

Do not touch any cleaned contact with your fingers. Salt and oil on th fingers is naturally present at all times An invisible film forms on any surfac contacted, and this leads to furthe corrosion.

Skating and/or no sound (ceramic)

There are several faults which ca cause skating with ceramic cartridges The most common is from wear or dam age to the stylus. If the tip is too wid to enter the record groove, the tonear will slide over the record surface towar the centre.

In less severe cases, the stylus wi start groove hopping, and may reac the centre of the record after ten rev lutions or so. If the yoke has collapse back into the cartridge housing, th stylus will follow suit, allowing the ca tridge to contact the record. Exce tracking weight or fractured ceram transducers will produce the sam effect.

If the complete cartridge is replace or a new player purchased, check to se whether the stylus guard is still in plac

No sound

The no sound condition may b caused by a faulty cartridge or broke connections. The fine wires attached t the cartridge connectors are easi broken. Check the four pin clips on th cartridge first. The soldering may be fault or a wire may be detached.

Some of these fine cables are held t the connection sleeves by means crimping. These are prone to loss electrical contact, although they may feel mechanically secure. Alternatively, one or more of the tubular connectors may be loose, and may be restored to a tight fit by squeezing gently with pliers.

Before re-fitting the clips, check for continuity between each clip and terminal strip beneath the deck. The four pins protruding from the rear of the cartridge housing are normally firmly fixed. Sometimes, however, the pins become loose and the internal connections are ost, although the cartridge may otherwise appear to be in good condition.

Sometimes the fine wires fracture in-ide the tonearm, and will go open cir-uit only when the tonearm is in a articular position. This can happen artway across the record; the sound ill suddenly cut off, then start again as he arm moves inward. On some decks, he exposed cable at the opposite end of he tonearm may be damaged. Any light movement of this may produce in-ermittent signals.

The only safe cure is replacement of he whole length, from the stylus to the erminal strip. Note that using cable of eavier size will drag on the tonearm nd either arrest the inward motion, or ause groove hopping.

eadshells and cartridges

Apart from the standard slide-on con-ectors, there are models fitted with eadshells which plug directly into the nearm socket. Most are generally held place by a threaded locking collar. uropean designs may employ a locking ver to secure the headshell. This often ubles up as a fingerlift as well. To re-ase the entire assembly, simply slide e lever horizontally.

Examine the pins and contacts for rrosion. These are often plated with ver for superior conduction proper-es. However, a reaction with airborne lphur fumes (vehicle emissions, etc) oduces a heavy tarnish ranging in lour from brown to dull black. With t strip contacts, use steel wool for eaning. Make sure that any strands of eel wool are removed before replac-g. With pin contacts, use a soft brass ush as with magnetic cartridges.

When there is no sound at all from e deck, check the stylus cantilever for rrect seating on the yoke. Sometimes e two may not be in close contact. e stylus fitted may be of the wrong pe or bent out of shape.

Alternatively, the yoke may be dis-rted (off centre) or the ceramic trans-ucers inside the cartridge may be acked.

Some of the cheaper crystal cartridges are subject to breakdown with rising humidity. Ceramics are not so prone to this; however, a few suffer the same fate after several years use, producing muffled and low level output. Replacement is the only cure.

Cartridge replacement (ceramic)

Ceramic cartridges come in all sorts of shapes and sizes. As there are some 1500 different types in use, an exact replacement may not be found.

Where mounting holes do not correspond with the holder or the headshell, some drilling and filing may be needed to fit the substitute cartridge. As a last resort, some types may be glued in position using contact adhesive.

Many cartridges are held in place by a clip system. The clip is fixed to the headshell by screws, and may be of plastic or thin stainless steel.

With the larger type, the distance from the clip base to the tip of the stylus is about twenty millimetres. If fitted to a deck, make sure that the tonearm lifts high enough to clear the record surface. In the case of automatic turntables (multiplay), up to six records may be on the platter. There must be enough space to clear the stack of records on the platter, and those on the dispensing spindle.

If the tonearm or cartridge fouls the edge of the record when feeding in, and the tonearm jams, then a lot of damage will be done to the delicate mechanism under the deck. This may take several hours of work to correct, if the deck is complicated.

Integral units

A few special types will be found with the headshell and cartridge integrated. The only way of removing the cartridge with this type is to break it into small pieces using a pair of sidecutters. The residue can then be cut away with a sharp knife. Do not try to force the unit apart with a screwdriver, as this will distort or fracture the shell itself.

Once the old cartridge has been removed, the replacement can be glued into position using contact adhesive (the original idea was to replace the whole tonearm as a unit).

Testing and operation

A large number of problems arise from failure or abuse. As both stylus and cartridge are user-accessible, expect anything. Many cartridges are damaged by owners attempting to replace the

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Servicing record players

stylus. Crystal and ceramic types are fitted with thin, brittle transducers. Too much pressure on the yoke will cause one or both to fracture.

When functioning correctly, vibrations from the cantiliver are transferred through the rubber yoke to the transducers. As the yoke moves, stresses are induced into the thin strips. This generates an electrical signal to drive the amplifier.

Always examine the transducers with a strong light and good magnifier. Both should appear straight and unbroken. The outer surface is silver coated, and the base material will appear white to light brown if exposed (cracked). If the yoke will not maintain a central position, suspect a fractured transducer, even though the damage may not be visible.

This condition may be checked by connecting a high impedance multimeter to two of the connecting pins (or leads) and lightly stroking the yoke or stylus tip with a finger. The highest resistance range should be used; a FET meter is the most suitable.

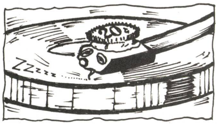
Movement of the needle should be approximately the same for both sides (left and right outputs). This method is useful as a means of identifying the connections on a cartridge, when a diagram is not available.

The cartridge may also be checked when connected to the amplifier; however, bear in mind that one of the leads may be broken, in the tonearm or elsewhere. This fault may not always be obvious, and a perfectly good cartridge may be discarded as a result.

Operation

In the magnetic cartridge, a tiny magnet is attached to the end of the cantilever to produce signals. With ceramic elements, the structure is far more complex.

The main body is flat and thin (approx 0.65mm) with four inner electrodes. The latter are circular in section, and evenly spaced across the width of the transducer. When viewed through a strong magnifier, the cross section resembles ribbon cable.



Tiny leads are attached to the surface by a thin coating of silver. In normal use, this method is adequate. The unit will withstand a fair amount of abuse. If the cartridge is dropped, however, the sudden shock load can strip the silver coating from the main body, particularly so on a hard surface, such as a wooden floor.

Much debate rages on how often a stylus should be changed. Sapphire is much softer than diamond, and 400 hours is considered a sensible limit before replacement.

Diamond styli have a recommended life of around 1,000 hours, or 2,000 sides.

Note that the above figures are for upper limits under ideal conditions. The records must be cleaned regularly and be free from dust and scratches.

The playing of worn, damaged (scratched) or dusty records may reduce the time to one half.

Interchangeability

Magnetic and ceramic cartridges are not interchangeable, due to differences in their output voltages and input resistance requirements.

If converting a deck to magnetic input, a preamplifier must be inserted before the main amp. Try a prebuilt unit from Dick Smith Electronics, Cat. number F-4152 (stereo). Some are also available in kit form from electronic suppliers, such as Jaycar Cat. number KE-4207.

Budget priced portable players are often fitted with a crystal cartridge. The output may range from three to 6V. If the unit is brought in with the cartridge missing, the only way that a correct replacement can be made is to look at the amplifier. With a crystal cartridge, the amplifier board is likely to contain only three transistors per channel, or the cartridge may feed a single IC directly.

Tonearm skipping grooves

This condition sometimes arises when the tonearm reaches a position several centimetres from the end of the recording. The arm will keep jumping back to one spot and refuse to advance. This causes torn grooves and permanent damage to the record.

This fault is due to the small slider plates mentioned earlier, which are mounted on the main gear. These plates are used to trip the automatic return of the arm.

As the tonearm traverses the record, the linkage attached to it moves slowly inwards. Near the beginning of the last track, the linkage encounters the two small plates attached to the main gear. If these plates are stiff, the linkage will stop, arresting the movement of the tonearm attached to it.

When this happens, the stylus will attempt to follow the record groove. It will do so until the side-pressure overcomes the tracking weight. At that instant, the stylus springs from the groove, and tension on the tonearm forces it backwards.

Both record(s) or stylus will sustain damage. With ceramic or crystal cartridges, the extra stress on the rubbe yoke may crack the thin transducer mounted inside. This can make on channel intermittent or inoperative With magnetic styli, the cantilever ma be bent out of shape or the diamond ti ripped from its mounting.

To correct this condition refer to th previous section on automatic retur (last month).

Multiplay decks: size selector problems

Some autochanger decks are fitte with a black plastic arm on the rear le side of the tonearm support pillar. Thi device is intended to catch the edge 30cm 33rpm discs as they fall from th record dispenser spindle on to the pla ter. If the arm fails to lock back, th tonearm will then assume a landin position to suit 18cm 33rpm discs.

The condition may be of constant intermittent nature, and is due to insu ficient lubrication on the associate linkages and plates directly under th plastic sensing arm. The mechanism very complex, so the dismantling of it not advised. Spray the components wit CRC-55, using the tube attachment reach difficult spots.

Cartridge change (hidden screw)

The screw fixing the cartridge to th headshell is sometimes covered by a aluminium decorator plate on top of th shell. This plate may be removed b carefully sliding the blade of a retrac able knife under one end. Keep th blade flat!

Eventually, the plate will lift and th cartridge can be replaced. The unde side of the plate is usually coated wit self-adhesive, thus making it easy to r attach. The use of liquid adhesive is n recommended as the cartridge may nee changing again at a later date.

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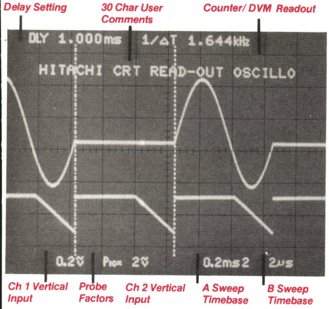

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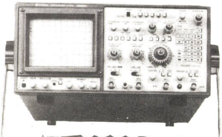

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Epson's elegant PC: neat and efficient

The name Epson is very well-known when it comes to printers for personal computers and is now beginning to build a reputation for personal computers too. Now Epson has decided to attack the biggest computer market of all — that of the IBM PC. Epson's PC is not just another slavish Asian copy of the IBM though. It has been designed from the ground up and looks quite different from the much copied IBM machine.

by LEO SIMPSON

While it would seem that the market for IBM-compatible machines is very over-crowded and the pickings very slim, it is easily the biggest segment of the market and potentially still very profitable. Hence it is not surprising that Epson, the company which has perhaps sold more printers to go with IBM PCs than any other manufacturer, should decide to enter the market in its own right.

Not that the PC is Epson's first entry into the market. It has had a number of machines in production for some time now. But the PC is the full frontal attack on the PC market and is the machine which is likely to interest most users. So what particular flair has Epson brought to bear in designing its own PC? The first answer to this must be the neat styling.

When I first saw this machine at a computer show I was immediately attracted to it. Here is a machine which looks right and which takes advantage of some of the advances which have taken place since the IBM machine was first introduced. It is more compact too, so it takes up less desk space. While it is roughly the same height and depth as the IBM unit, it is less wide at 362mm versus 495mm. Epson was able to achieve this by stacking two half-height disc drives in the space needed for one full-height drive.

To the left of the drives are two small doors which flip down. The top one conceals the on-off switch. This is a small point but it is so much better than having it at the back as on the IBM. The other small door conceals the DIN socket for the keyboard which again is
better than the rear socket on the IBM

Below the disc drives is another wide
door which conceals a set of ten DI
switches. Once again this is much mor
convenient than the similar switch insid
the original PC. Also in this compar
ment is a reset switch which is a nic
feature. It let's you do a "warm boot
of the system without having to pre
the Ctrl, Alt and Del keys simulta
neously, which cannot be done in case
where the computer "crashes" an
refuses to respond to the keyboard.

(A "warm boot" of the system simpl
means reloading the discs without turn
ing off the computer which would no
mally cause the machine to go throug
its complete memory check procedure.

The Epson keyboard is about th
same size as that for the IBM machin
but has a number of differences in th
key layout. For a start, the Epson ha
bigger Enter, Shift and Ctrl (contro
keys and the numeric keypad is slight
separated from the typewriter key
Also moved are the keys for Prt
(print screen), | and ~ character
which sometimes cause problems f
people used to conventional typewrit
keyboards. Surprisingly though, th
Epson does not have LED indicato
for the Caps Lock and Num Lock ke
(the latter changes the numerical ke
from cursor movement keys) which is
definite drawback of the IBM keyboar

Clip-out legs on the keyboard allow
to be adjusted for a better typing ang
while rubber feet stop it from skati
about on the desk surface. Over
weight of the keyboard is somewhat le
than the IBM model because of the a
plastic construction which is used
most competing manufacturers.

The keyboard action is quite go
though not quite up to the standard
the IBM which is still the best of a
machine on the market, if you are
typist. If you're not a journalist thoug
this point is not so important.

SPECIFICATIONS

CPU	80C88 (4.77MHz)
ROM	16KB
RAM	Main RAM 512KB
Keyboard	Full-size, qwerty configuration
Interfaces	Centronics compatible port; RS-232C serial interface port
Operating system	Epson MS-DOS version 2.11
Disc drive	Two 360KB floppy disc drives standard: 20MB hard disc drives optional
Options/peripherals	Colour video board; monochrome video board; IBM PC options and peripherals

The rear of the Epson is also neater than the IBM. Standard features are the horizontally mounted DB-25 sockets for serial (RS232C) and parallel (Centronics) ports. Mains input and output is via IEC sockets (same as on the IBM PC). Neatest feature of the lot is the use of moulded plastic covers for the expansion slots. While there are five expansion slot covers on the rear panel, there are actually only three slots provided for the Epson PC and one of these will always be occupied by the monitor driver, which may be high resolution monochrome or colour graphics, both to the IBM standards. The review sample was fitted with a colour graphics board to drive a standard RGB monitor.

Another feature of the styling is the provision for standing the case on its side, with an optional desk stand. This can be useful, particularly if the processor is to be positioned off the desktop.

But while Epson have made the PC a very neat package, they haven't made it easy to get into. To get inside the case, which you have to do if adding one of the expansion boards, you have to remove seven screws (two of which are covered), the side mounting feet, the moulded back panel and then the sheet-metal top. This reveals a neat interior which should be reasonably straightforward to service, if ever necessary.

The Epson PC is supplied with two 360KB disc drives as standard, but can be fitted with a 20MB hard disc in place of the second floppy.

Standard model and variants

As supplied, the Epson PC comes with 512 kilobytes of RAM as standard and it can be expanded up to the full 640K if desired. It employs the 80C88 processor running at 4.77MHz so that all programs run on the Epson will run at essentially the same speed as on the IBM PC.

The disc drives are standard 360KB 5.25in double-sided double density. Some users may wish for the higher capacity 3.5in format but Epson's choice has two advantages: IBM compatibility and lower cost for blank floppies. As an option, the Epson PC can also be supplied with one floppy disc drive and a 20 megabyte hard disc in place of the second floppy.

In the last month or so, Epson have released a higher performance variant of the PC. Called the PC+, it comes with 640K of RAM, a V30 processor (NEC's higher performance version of the 8088) with selectable operating speeds of 4.77MHz or 7.16MHz, three-mode video controller board, clock calendar and five expansion slots. Then there is the PC+HD model which adds the 20MB hard disc in place of one floppy, to give a really high performance machine in a very compact package.

Software and documentation

The only software supplied with the Epson PC is Microsoft's MS-DOS version 2.11. This is supplied on a single floppy together with a number of utilities which may help beginners because they present a number of DOS (disc operating system) commands in a menu format. If you're already familiar with MS-DOS or PC-DOS, these utilities will be of little use.

Unlike the IBM PC, the Epson is not supplied with a ROM-based version of Basic, nor does it have Basic on the supplied DOS disc, as does the IBM. However, as part of its merchandising the Epson can be bundled with GW Basic, if desired.

Epson's documentation is very good. There are three spiral bound manuals which are packed in a carton along with the MS.DOS floppy disc. The first of these is the 56-page operations manual entitled "Setting Up and Getting Started". This is well written and illustrated so that it is easy to follow, especially for the novice operator who is setting up a system for the first time.

The second book is the 327-page "MS-DOS Reference Manual". This is the best written book on the subject of DOS that I have come across. It is streets ahead of the labyrinthine manual on IBM's PC-DOS. For this manual alone, the Epson must get full marks. Also good is the third manual entitled "Everyday with MS-DOS", which is more of a quick reference guide to oft-used commands.

Turning on the Epson is straightforward — just flip down the little door and press the On button. None of this reaching round the side to pull up a massive clunker of a switch. But then it comes as something of a shock to realise that Epson have managed to include a cooling fan which is even noisier than that for the IBM PC. Why can't these things be quiet? In my opinion, the fan on this machine is its worst feature. It takes away from its overall refined presentation.

By contrast with the fan, the Epson's disc drives are reasonably quiet and are not clunky like the drives on some machines.

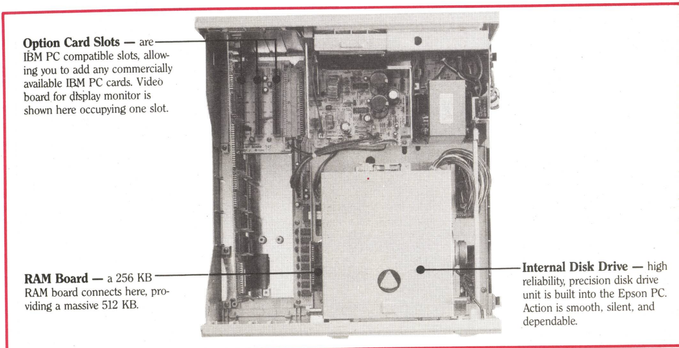
In use, the Epson presented no problems at all with a variety of software. Epson claim to have used it with a wide variety of software and also claim to have used it with a large number of IBM expansion boards without finding incompatibility.

We have to conclude that the Epson PC is a fine machine which is sure to satisfy lots of users, giving many years of trouble-free service. Our only quibble is that noisy fan. Aside from that, Epson buyers have the advantage o continued backing from a large Japanese company with a proven track record in printers.

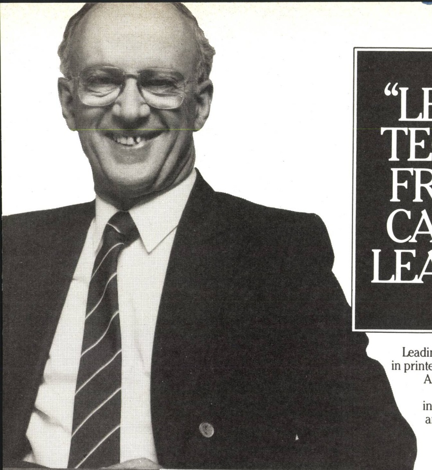
Recommended retail price of the Epson PC with two disc drives is $2450 plus tax. Fitted with a 20MB hard disc the price is $3950 plus tax. For the Epson PC+, the recommended retai price is $3950 plus tax while the PC+HD is $5350 plus tax. None o these prices includes a video monitor.

For further information, contact you computer dealer or Epson Australia Pt Ltd, Unit 3, 17 Rodborough Rd Frenchs Forest, NSW 2066. Phone (02 452 5222.

(Editor's note: A review of the com panion EX-800 Printer has had to be held over till next month.)


Option Card Slots — are IBM PC compatible slots, allowing you to add any commercially available IBM PC cards. Video board for display monitor is shown here occupying one slot.
RAM Board — a 256 KB RAM board connects here, providing a massive 512 KB.
Internal Disk Drive — high reliability, precision disk drive unit is built into the Epson PC. Action is smooth, silent, and dependable.

Reproduced from a brochure, this internal view shows the neat layout inside the Epson PC. The machine should be reasonably straig forward to service, if ever necessary.



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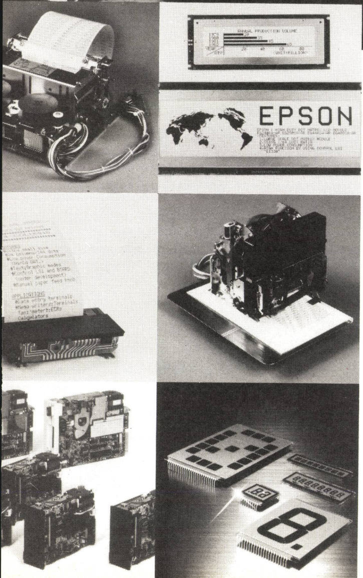

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New Products...

Product reviews, releases & services

Radio communication analyser from STC

The Anritsu MS555A Radio Communication Analyser is a portable test instrument with a frequency range of 25 to 1000MHz. It incorporates all the necessary instruments for both transmitter and receiver testing and can measure such fundamental characteristics as output power, frequency, FM deviation, sensitivity, S/N ratio, and distortion.

The frequency stability and low residual noise of the built-in signal generator make this device suitable for the production and maintenance of narrow band transceivers and radiotelephone systems.

In addition the self-contained microprocessor provides optional automatic measurement and data printing. An IEEE-488 option is available for a computer-controlled GP-IP system.

For further information contact Standard Telephones and Cables Pty Ltd, 58 Queensbridge Street, South Melbourne, Vic. 3205. Telephone (03) 615 6677.

PCB fault locator

Emona has announced a PCB faul tracer that detects and locates short circuits, devices loading down Vcc and bu and multilayer circuit faults.

It is useful for both analog and digita circuits.

The Toneohm 700 combines the milliohm-meter and current probe capabilities of the existing Toneohm 550 an 580 instruments with an additional microvoltmeter which can measure th voltage drop along a PCB track.

During track short location, th Toneohm 700 produces an audio ton which rises in frequency as the probe are moved nearer the short. The poi of highest frequency will be within 2 t 3mm of the short.

For multilayer and bus faults, th Toneohm has a sensitive magnetic fiel probe which can detect current flow i side an IC or shorted capacitor (tantalum), or within layers of a multilaye PCB. Shorts and partial shorts can b located by following the current flo Where several devices are connected t an address or data bus, the faulty I can be quickly located.

The Toneohm 700 also measures vol age with 1µV resolution. By using th audio tone feature, a DC current pat can be followed along a PCB trac This feature allows the detection of device loading down the board's V line.

For further information conta Emona Instruments Pty Ltd, PO B K720, Haymarket, NSW 2000. Tel phone (02) 212 4599.

Range of standard diode arrays

A new range of standard diode arrays is available in Australia from Allen-Bradley Pty Ltd. Three standard types are available:

(1) Type A — common anode, up to 18 diodes, 19 pins maximum.

(2) Type C — common cathode, up to 18 diodes, 19 pins maximum.

(3) Type I — isolated diodes, up to 10 diodes, 20 pins maximum.

These diode arrays are based on equivalents of the 1N4148 high speed diode and have an operating temperature of −40°C to +125°C.

For further information contact Allen-Bradley Pty Ltd, 22 Parramatta Road, Lidcombe, NSW 2141. Telephone (02) 648 2652.

New video recorder has improved picture quality

THIS new hifi VCR from JVC boasts a comprehensive range of features and specific tions, including JVC's so-called HQ (high quality) picture technology and infrared remo control. According to JVC, the HQ system consists of a detail enhancement circuit ar features a 20% higher white clip level. This is said to provide a clearer, sharper pictur For further information contact Hagemeyer (Australasia) B.V., 5-7 Garema Circui Kingsgrove, NSW 2208. Telephone (02) 750 3777.

Optical wavelength meter

The model MF91A optical wavelength meter from Anritsu can be used to measure the optical power and wavelength of light emitting diodes and laser diodes.

With its three plug-in modules, the device can cover the wavelength range of 0.4 to 1.6μm. Optical power can be measured over the entire wavelength range without recalibrating the wavelength sensitivity.

For further information contact STC Pty Ltd, PO Box 42, Thornbury, Vic 3071. Telephone (03) 480 1255.

Scan Audio to distribute Ortofon cartridges

Melbourne-based distributor Scan Audio has been appointed Australian distributor for Ortofon cartridges. The appointment is to take effect immediately.

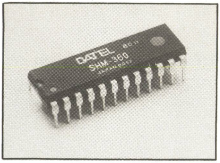
Scan Audio specialises in high quality audio products from Denmark. For further information contact Scan Audio Pty Ltd, PO Box 242, Hawthorn, Vic 3122. Telephone (03) 429 2199.

Sample/hold amplifiers

Datel has expanded its line of sample/hold amplifiers with the new fast SHM-360 and SHM-361 ICs.

These are monolithic bipolar ICs designed for ultra-fast sample/hold analog to digital (A/D) converter applications. Both devices operate from power supply voltages of ±5V, and accept ECL compatible input voltages of ±3V, with 60kΩ input impedance.

Included in the ultra-fast sample/hold circuit is a wide bandwidth (50MHz) input amplifier, a reference power supply voltage for the A/D converter and a clock timing signal for driving the A/D converter. The latter eliminates the need for an external clock.



For further information contact Elmeasco Instruments Pty Ltd, 15 McDonald Street, Mortlake, PO Box 30, Concord, NSW 2137. Telephone (02) 736 2888.

Switchable DIP attenuators

The VRN series 7010 switchable DIP attenuator is a laser trimmed thick film resistor network, with a high quality gold contact switch system. The network is internally moisture sealed with a silicone coating and externally sealed with an epoxy barrier.

The S7010 is a balanced T-type attenuator, available in 50Ω, 75Ω and 60Ω impedance values. Their power rating is 0.25W with an insertion loss of 0.02dB and an operating temperature of 0° to 75°C.

For further information contact IRH Components, 32 Parramatta Road, Lidcombe, NSW 2141. Telephone (02) 648 5455.

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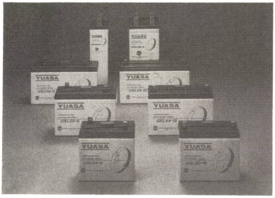
SEALED LEAD-ACID STATIONARY BATTERY

UXL SERIES

10 YEARS LIFE

Conventional vented type stationary batteries require water replenishment due to water decomposition during charge. The "UXL Type" battery introduced herein incorporates further the maintenance-free design which eliminates such troublesome maintenances as electrolyte level check, water topping-up, specific gravity measurement and equalizing charge, making the battery truly maintenance free. This is a sealed type stationary lead-acid battery of long life, high reliability and high performance, which has been developed based on the technologies of the small size sealed batteries.



UXL Saves up to Half on Space

Ex. UXL220-2

GENERAL SPECIFICATIONS

Battery Model	Nominal Voltage (V)	10HR Nominal Capacity (AH)	Dimensions (mm)				Approx. Weight (kgs)
			Length	Width	Height	Overall Height	
UXL33-12	12	30	235	128	190	217	16
UXL44-12	12	40	299	128	190	217	20
UXL55-12	12	50	363	128	190	217	24
UXL66-6	6	60	217	128	190	217	15.5
UXL88-6	6	80	281.2	128	190	217	19.5
UXL110-6	6	100	345.4	128	190	217	23.5
UXL220-2	2	200	170	106	330	362	16
UXL330-2	2	300	170	150	330	362	24
UXL550-2	2	500	241	171	330	362	39

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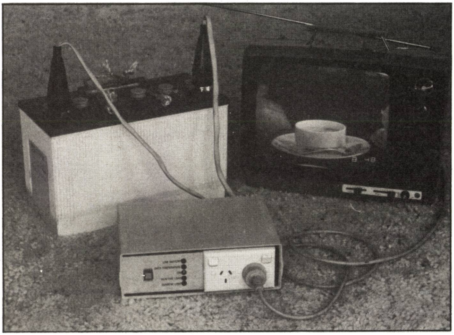
DC-AC sine wave inverter



Designed and manufactured in Australia, this 12-120V DC-AC converter boasts a 300W peak output and is housed in a compact case measuring just 260 x 190 x 80mm (W x D x H).

Main features of the Power Converter include: autostarting, full current limiting, input reverse polarity protection, battery under voltage cutout, full voltage regulation, and full transient suppression and protection. The device is also short-circuit proof, has thermal overload cutout and twin power outlets, and features a sinusoidal output waveform with less than 5% distortion.

The Power Converter can be supplied in a plastic case or in a rugged, water resistant metal case. Similar units rated at 800W, 1000W and 3000W will be available in the near future.

For further information contact Modulite Pty Ltd, Factory 6, 42 New Street, Ringwood, Vic. 3134. Telephone (03) 879 2825.

Computer chess from Dick Smith

If you thought that chess was a game that took two to tango, think again! The advent of computer-controlled chessboards means that the game can now be played alone.

Dick Smith Electronics Pty Ltd has two new advanced computerised chess games which are suitable for players of all levels — from novice to tournament level.

The low-cost "Piccolo" is a compact, lightweight portable chess game that makes an ideal travelling companion. It features eight skill levels and, unlike many computer chess games, Piccolo is programmed with international chess rules: en passant moves, castling and pawn promotions, check, stalemate and mate announcements.

The second game, the "Allegro", has the appearance of a traditional chess board. It has all the features of the Piccolo plus a 24K memory for storing and recalling past moves.

The Piccolo retails for $69.95 and Allegro for $139.95.

For further information contact Dick Smith Electronics Pty Ltd, PO Box 321, North Ryde, NSW 2113. Telephone (02) 888 3200.

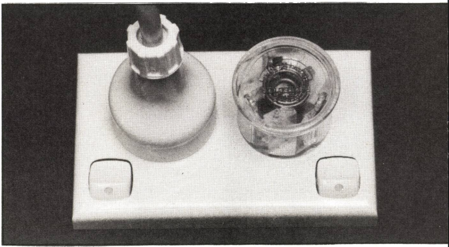
Spike protector for mains equipment

The Bowthorpe Spike Protector Button is designed to protect computers, hifi systems, VCRs, VDUs, cash registers, telephone exchanges and other sensitive electronic equipment against spikes or surges on the power lines.

No wiring is required — the device simply plugs into the socket adjacent to the equipment to be protected, or can be used on a piggyback plug. For transients originating outside the premises, the device is fitted to the socket nearest the distribution board so that it can protect equipment plugged into other outlets on the same branch circuit.

The Button is designed to dissipate 150 joules of electrical energy with a response time of 10 nanoseconds and consumes no power except when the surge is present. It protects all modes (ie line-neutral, earth-neutral, and neutral earth) and is maintenance-free.

For further information contact Bowthorpe Australia Pty Ltd, 105 Cawarra Road, Caringbah, NSW 2229. Telephone (02) 525 2133.



Force Electronics

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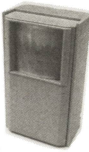

Infra Red Movement Detector

With interchangeable lens for corridor or wide angle detection

The infra Red or IR detector for short is basically a high gain passive tuned receiver of a particular IR band. The heart of the unit consists of a high gain lens (antenna) which has a "Commutated" field of view. Its reception pattern is comb-like, but highly tuned to the IR wavelength of human bodies. When a human passes within proximity of the pickup area, the lens will selectively pick up IR radiation and then not. Movement across the pickup area will result in a series of pulses sent to a detector circuit. IR detectors are very reliable as they do not transmit and will not respond to non heat radiating objects.

Features:
- Lens simply 'snaps' to either **wide angle** (range 40 feet) for normal use or **Normal angle** (range 80 feet plus) for corridor applications.
- Snazzy integral mounting bracket allows corner 90 deg. mounting as well as normal surface mount.(This is a fantastic feature as these work best in corners and are visually unobtrusive)
- 12V DC Powered
- Built-in test lamp
- Alarm output SPDT 30V 1a

S 5301

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Erase your EPROMS quickly and safely. This unit is the cost-effective solution to your problems It will erase up to 9 x 24 pin devices in complete safety in about 40 minutes for 9 chips (less for less chips). • **Erase up to 9 chips at a time** • Chip drawer has conductive foam pad • Mains Powered • High UV intensity at chip surface ensures thorough erase • Engineered to prevent UV exposure • Long Life UV tube • Dimensions 217 x 80 x 68mm • Weight 670 grams

Universal Monitor Stand

With Pan & Tilt Adjustment

This brilliant monitor stand enables you to swivel left/right and tilt up/down i.e. to position monitor to any desired position. Hence viewing position is enhanced and screen glare eliminated. **D 1100**

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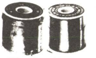

Superb Resin Cored Australian Solder with "tip sav" additive. Handy 1mm guage suits fine PCB soldering equally well with general purpose service work. 200gm Reel. **Cat.T1200**

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$19.95

High level leakage of hazardous radiation from the Microwave oven may occur due to damage or wear of sealing surfaces, the door, the door hinges or the door latches, Microtek is designed to detect the microwave leakage and to display the relative radiation strength on a level meter. Should the radiation reach a dangerous level, qualified personnel should be called upon for thorough checking and repair. It can detect radiation as low as 0.1 milliwatts per square centimeter. **A 0900**

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20 Watts Max.Power with In-Built Whistle

A new product for 1986, our A 1990 Megaphone PA is quite simply one of the finest around irrespective of price. This is an extremely sturdy unit with a quality in-built 20 watt (max) low distortion amplifier. **Another Secret** of the fine performance is the incorporation of a noise cancelling micrphone - the result is a surprising level of gain available **without feedback** even when used indoors in relatively confined spaces.

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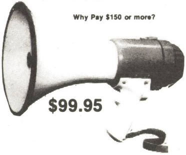


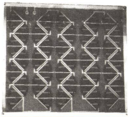
$99.95

Price Break Through Solar Cell Array 18V @ 7 Watt

Brilliant New Solar Array at an amazing price. Yes, for less than $90 we now have just the handiest Solar Modules available (Why pay our competitors $239 for a measly 3 additional watts?? Superb for Powering or Charging 12 - 15 Volt circuits - Now there's now excuse for that flat Car, Boat or Caravan Battery. Solar Cells are fixed to a fibre board, front covered with tough EPS and rivetted into stainless steel frame. **Cat No. A 0220**

Amazing Price Break Through

$89.95



High Definition Computer Monitor

New Micron Series 3

There are a number of low cost 'Hobbyist' monitors around these days at prices unheard of a year or so ago. However, they all suffer from poor to medium definition or resolution—hence eye strain becomes a real headache. The situation has all changed with the release of the superb **Micron Series 3.** Non glare, naturally, and screen character resolution well worthy of mating up with top end personal or professional computers.

• 1050 lines resolution at centre screen • 22 MHz band width • Video input impedance switch allows networking use.

Specifications:
Screen—Green phosphor **Front Controls**—Power On/Off, character brightness/intensity, display centering **Rear Controls**—Background intensity, vertical and horizontal adjustment etc. **Input Impedance** Switch 75/10K **Bandwidth**—10Hz-22MHz **Resolution**—1050 lines minimum at centre screen.
D 1115

Green Non Glare $199

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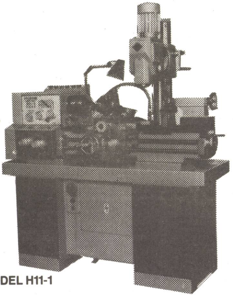

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A heavy-duty professional unit which Turns, Mills, Screw Cuts, Grinds, Drills, Slots, Gear Cuts . . . and more. All cutters, slot drills, etc., are Standard Equipment. Workable diameter 150mm. Max. length of work 550mm. Driven by 2-spead heavy duty electric motor. A real workhorse at an economical price. Built to Government Ordinance Factory Standards.

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PROTEL-PCB

LOW COST PROFESSIONAL QUALITY MULTILAYER PRINTED CIRCUIT BOARD DESIGN PROGRAM VERSION 2.0

For IBM* AND COMPATIBLES plus the NEC ** APCIII PERSONAL COMPUTERS

PROTEL-PCB software is written in Australia and allows you to create, correct and plot camera-ready artwork. PROTEL-PCB eliminates time consuming tape up methods.

• Check the list of new features and you will see that the program has been further enhanced as a low cost professional quality program. The Program now allows the design of circuit boards to 32 x 19 inches. The user can view and work on the entire PC at once, or with five levels of zoom work on particular areas as small as 1.6 x 0.95 inches on the full screen of the VDU. Camera ready 1:1 or 2:1 ink plots are available as is 1:1 or 2:1 rapid colour plots of all layers.

PROTEL-PCB Version 2.0 new features

- *Grid Size down to 0.001 inches, select 9 sizes.*
- *Maximum PCB dimensions 32 x 19 inches.*
- *Five zoom levels from 32 x 19 to 1.6 x 0.95 inches.*
- *Extensive Library facilities, predefined components.*
- *Rubber banding, move components and maintain tracks.*
- *Bill of Quantities, produced as text file.*
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- *Track breaking, deletion and stretching capabilities.*
- *Seven text sizes can be rotated or mirrored.*
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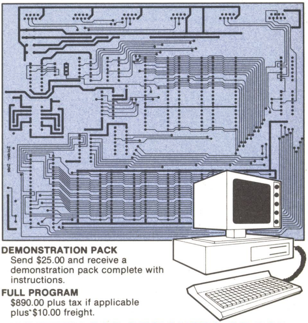
- *Adjustable plot starting point.*



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FULL PROGRAM
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*Registered Trade name of IBM
**Registered Trade name of NEC Information Systems Australia

New Products...

Plasma display screens

A new range of plasma display screens, suitable for use in lightweight, portable monitors for computer keyboards, has been released by Amtex Electronics.

Amtex has been appointed a distributor for OKI in Australia and has released two equipment ranges, the SS series of graphics screens and the DSA series of character plasma displays.

Applications for these units include point-of-sale and banking terminals, measuring instruments and numerical control machines, telecommunications equipment and office systems.

The graphics panels come in six models and offer display areas (measured in number of dots) ranging from 96(W) x 16(H) to 640(W) x 400(H). The alphanumeric panels come in 15 models, two screen colours of neon orange or green, and offer display areas from 64 characters to 1920 characters. These come with or without controller circuits to match individual needs and applications.

Plasma displays use a cold cathode, gas discharge tube where the cathode and anode are exposed to a rare gas sealed inside a glass container.

For further information contact Amtex Electronics, TLE Electrical Pty Ltd, 36 Lisbon Street, Fairfield 2165. Telephone (02) 727 5444.

Miniature polyester capacitors

Manufactured in Japan by Nissei Co Ltd, the AMZ miniature polyester capacitor is specifically designed for radial PCB insertion and is supplied on bandolier tape conforming to the 5mm industry standard, lead spacing pitch.

The stock range includes capacitance values from .0047μF to 0.47μF in 50V DCW with 10% tolerance. Higher voltages and/or close tolerance 5% types are also available.

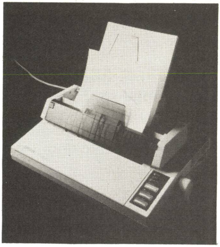
For further details contact Soanar Electronics Pty Ltd, 30 Lexton Road, Box Hill, Vic 3128. Telephone (03) 895 0222.

Spectrum analyser covers 10kHz-2GHz

Just released by STC, the Anritsu Spectrum Analyser MS610B is a compact, lightweight instrument which covers the frequency range from 10kHz to 2GHz. It features a coupled function which boosts measuring efficiency and a digital display function

The MS610B also provides for upgrading functions to a general-use spectrum analyser. There is a GP-IB interface to facilitate automatic measuring and a noise field measurement function

For further information contact STC Pty Ltd, PO Box 42, Thornbury, Vic 3071. Telephone (03) 480 1255.



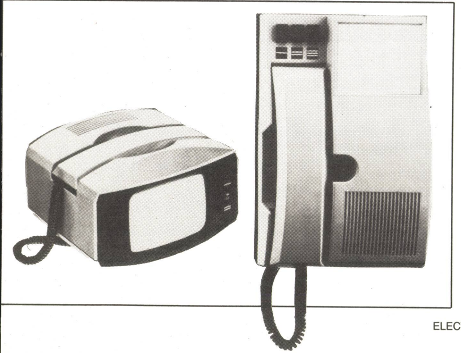
New 80-column dot matrix printer

A new 80 column dot-matrix printer has been released by Epson Australia. Designated the LX-86, it is a development of the company's highly successful LX-80 and is easy to use, fast and IBM compatible.

Standard features now include Roman NLQ font, a mode selection control panel, expanded ESC/P, word processing capability and an IBM graphics character set.

The LX-86 incorporates a 1K byte input buffer and achieves print speeds of 120cps. Other features include data and hex-dump support, the ability to interface with Centronics hardware, and a long-life ribbon (1.5 million characters).

For further information contact Epson Australia Pty Ltd, Unit 3, 17 Rodborough Road, Frenchs Forest, NSW 2086. Telephone (02) 452 5222.



New range of video/audio intercoms

A new range of Elvox residential video and audio intercoms has been released through Cunningham Communications Pty Ltd. The range of equipment allows for single residences to multi-unit apartments to benefit from the security of either audio or video/audio intercoms.

The audio intercoms come as a do-it-yourself kit for single residences with either one or two telephone handsets.

Single kits are also available for video and audio intercoms, and monitors are available as recessed wall mounting, flush wall mounting and table mounting.

For further information contact R.H. Cunningham, 100 Gladstone Street, South Melbourne, 3205. Telephone (03) 690 9988.

New Products...

Hand-held 50MHz frequency meter

The MAX-50 50MHz, hand-held frequency meter is about the size of a scientific calculator and operates from a 9V alkaline battery for field applications, or a plug-in battery eliminator for bench operation.

Its key features include a 6-digit display which is formatted with decimal points at both kilohertz and megahertz positions. The least significant (rightmost) digit always displays hundreds of hertz. The display updates at the rate of six readings per second.

The only control is the power on/off switch. Signal coupling can be made either via a small accessory antenna or directly via a mini phono jack adjacent to the antenna connector. The unit is supplied complete with the antenna, input cable and an instruction manual.

The MAX-50 is intended for utility applications such as field service, bench service, transmitter maintenance, and transceiver repairs. According to the manufacturers, the unit has a sensitivity of 30mV RMS (100Hz to 30MHz); and 100mV RMS (30MHz to 50MHz). Resolution is 100Hz, weight is 227 grams and the operating temperature is 5-45°C.

For further information contact R.F. Devices Pty Ltd, PO Box 161 Miller, NSW 2168. Telephone (02) 607 8811.

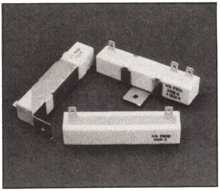
LCDs with backlighting

Distributed by Amtex Electronics, th DMC series Optrex LCD displays a now have backlighting as a standar feature. The DMC series are alphanumeric displays ranging from 16 characters x 1 line to 40 characters x 4 lines Customers not requiring backlightin can simply ignore the connections to th electro-luminescent (EL) pad.

A small inverter is required to provide the 100V 400Hz output to drive th EL pad. The EL pad itself is a flexible flat surface light source using an organi film as substrate and encapsulated fo protection. The 1.3mm thin pad is fitte behind the actual display. The backlighting is a uniform bluish-green colour.

The input voltage to the inverter i 1.5 to 5VDC with the brightness proportional to the input, and the lifetim inversely proportional.

For further information contac Amtex Electronics, 36 Lisbon Street Fairfield, NSW 2165. Telephone (02 728 2121.



High-power flameproof resistors

The range of Australian manufactured PW series wire wound resistors, manufactured in Sydney by IRH Components, has been expanded with the introduction of the PW50 series which feature a 50W rating.

The PW50 has been designed for use in the automotive and electrical industries (eg, in appliances) and is ideal where a robust low-cost resistor is required.

Main features of the PW50 include 6.3mm male quick connect terminal horizontal or vertical mounting brac ets, plated terminals to meet electric authority specifications, and a wi range of values. A centre-tapping ve sion (adjustable between 30% and 70 of total resistance) is also availab (PW50T).

For further information contact IR Components Pty Ltd, 32 Parramatt Road, Lidcombe, NSW 2141. Tel phone (02) 648 5455.

Clamp-on radio frequency choke

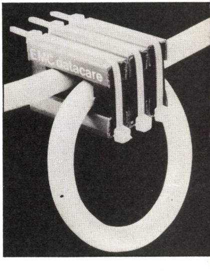
New from EMC Datacare, the D910 Series clip-on radio frequency (RF) choke is designed to alleviate radio frequency interference (RFI) problems in domestic radio, TV and audio, as well as in professional computers, process control and telecommunications systems.

An introductory D918 kit of eight choke cores and associated hardware is available, complete with application notes.

Most RFI problems arise from cables acting as antennas. Usually unwanted signals are 'common mode'; that is, they can be visualised as travelling along the outside of the cable and can be reduced without affecting the normal function of the circuit.

The D910 Series common mode chokes can be installed on cables of up to 10mm diameter without the removal of any connectors. For large or rigid cables, several pairs of cores are required; for smaller flexible cables multiturn chokes may be fashioned from the same components to provide impedance to interference currents.

For further information contact Novatech Controls Pty Ltd, 429 Graham Street, PO Box 240, Port Melbourne, Vic. 3207. Telephone (03) 645 2377.



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	10-99	100+	1000+	10K+
4164-15P	$ 2.00	$ 1.70	$ 1.65	$ 1.60
41256	$ 4.50	$ 4.00	$ 3.60	$ 3.30
6116P-3	$ 3.00	$ 2.90	$ 2.20	$ 2.00
2716	$ 7.50	$ 7.00	$ 6.50	$ 6.00
27128	$ 5.00	$ 4.50	$ 4.00	$ 3.50
2532	$ 7.50	$ 6.50	$ 6.40	$ 6.30
2732	$ 6.50	$ 6.10	$ 5.90	$ 5.50
27256	$ 9.00	$ 8.00	$ 7.00	6.50
6264	$ 5.50	$ 5.00	$ 4.50	$ 4.00
2764	$ 6.00	$ 5.00	$ 4.50	$ 4.00

Plus 20% tax where applicable

NICADS

Cat No.		1-99	100+	250+
S15020	AA 1.2AH	1.70	1.50	1.40
S15020	C 1.2AH	4.50	4.25	3.50
S15020	D 1.2AH	4.90	4.75	4.50

Plus 20% tax where applicable

RESISTORS

¼ WATT E12 CARBON BULK
PACKED $5.25/1000
TAPED AND BOXED $5.25/1000
$5.00/1000 10K LOTS
¼ METAL FILM TAPED AND BOXED
$12.00/1000 $11.00/1000/10K LOT
SUPPLY E24 VALUE
Plus 30% tax where applicable

TRANSISTORS

Desc.	10-99	Desc.	10-99
2SJ49	5.50	2SK134	5.50
PN2222A	.10	PN2907A	.10
PN3463	.15	PN3565	.12
PN3566	.15	PN3567	.10
PN3569	.18	PN3639	.18
PN3640	.18	PN3641	.10
PN3642	.10	PN3643	.10
PN3644	.15	PN3645	.15
PN4250A	.15	PN4355	.16
PN4356	.16	MPSA42	.23
MPSA43	.23	MPSA55	.15
MPSA56	.15	MPSA92	.22
MPSA93	.22	SC1410	.85
BU126	1.50	BUX80	2.50
BU208	2.50	2SD350	2.75
BU326	1.75	BC547	.07
BC548	.07	BC549	.07
BC557	.07	BC558	.07
BC559	.07		

Plus 30% tax where applicable

MINIATURE BUZZER

5-15V White or black.

Cat. C15062	10-99	100+
	0.90	0.80

Plus 20% tax where applicable

AXIAL ELECTROLYTICS

Cat. No.	Description	10+	100+
R15705	0.47uF 63V	$0.12	$0.10
R15715	1uF 63V	$0.12	$0.10
R15725	2.2uF 63V	$0.12	$0.10
R15742	4.7uF 25V	$0.11	$0.09
R15745	4.7uF 63V	$0.11	$0.09
R15761	10uF 16V	$0.12	$0.10
R15762	10uF 25V	$0.13	$0.12
R15765	10uF 63V	$0.15	$0.14
R15792	22uF 25V	$0.13	$0.12
R15794	22uF 50V	$0.17	$0.15
R15812	25uF 25V	$0.13	$0.12
R15815	25uF 63V	$0.17	$0.15
R15831	47uF 16V	$0.16	$0.13
R15832	47uF 25V	$0.16	$0.13
R15835	47uF 63V	$0.22	$0.19
R15841	100uF 16V	$0.18	$0.16
R15842	100uF 25V	$0.18	$0.16
R15845	100uF 63V	$0.27	$0.24
R15851	220uF 16V	$0.17	$0.15
R15852	220uF 25V	$0.21	$0.18
R15855	220uF 63V	$0.50	$0.46
R15871	470uF 16V	$0.27	$0.24
R15872	470uF 25V	$0.29	$0.27
R15873	470uF 35V	$0.75	$0.70
R15875	470uF 63V	$0.75	$0.70
R15885	1000uF 63V	$0.60	$0.58
R15891	1000uF 16V	$0.39	$0.35
R15892	1000uF 25V	$0.45	$0.40
R15893	1000uF 35V	$0.70	$0.65
R15894	1000uF 50V	$0.00	$0.00
R15903	2200uF 35V	$1.20	$1.10
R15904	2500uF 50V	$1.30	$1.20
R15911	2500uF 16V	$0.59	$0.50
R15912	2500uF 25V	$0.95	$0.90
R15913	2500uF 35V	$1.10	$1.00
R15914	2500uF 50V	$1.30	$1.20
R15932	4700uF 25V	$1.90	$1.80
R15933	4700uF 35V	$2.40	$2.15

Plus 30% tax where applicable

TRANSFORMERS

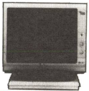
Cat No.		1-99	100+	1000+
M12851 240V 12-6V CT 150mA	2851	2.50	2.25	1.90
M12155 240V 6-15V 1A tapped	2155	4.80	4.10	3.70
M12156 240V 6-15V 2A tapped	2156	6.35	6.15	5.95
M16672 240V 15-30V 1A tapped	6672	6.35	6.15	5.95
M12860 240V to 15V C.T. at 250mA	2860	3.00	2.50	2.30
M12840 240V to 9V C.T. at 150mA	2840	3.00	2.50	2.30

Plus 20% tax where applicable

75 OHM COAX IN 100M ROLLS

Cat No.	1-4 rolls	10+ rolls
W11222 3C2V	19.00	17.00
W11224 5C2V	29.00	26.00

(5C2V WHITE OR BLACK)
LINE LOSS PER 100 FEET
(33M 200MHz)
W11222 3C2V 6.2dB (Approx.)
W11224 5C2V 3.9dB (Approx.)
Plus 20% tax where applicable



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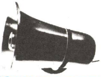
	1-9	10+
Green Cat. X14506	$145	$135
Amber Cat. X14508	$150	$140

Plus 20% tax where applicable

TELEPHONE CABLE (200 METRE ROLLS)

		1-9	10+
W11302	2 Pair	25.00	24.00
W11303	3 Pair	37.00	35.00
W11310	10 Pair	120.00	115.00

Per 200m Roll
20% Sales tax where applicable



HORN SPEAKERS

Cat No.		
C12010	5" Plastic 10W Max	4.80
C12015	5" Metal 10W Max	4.70
C12012	12V Siren	8.50

Plus 20% tax where applicable

GREY FLAT RIBBON CABLE

Cat No.	Desc.	Per Mtr	PER 100 FT ROLL 1-3	PER 100 FT ROLL 4-9
W12614	14 Way	1.29	19.50	18.50
W12616	16 Way	1.90	21.50	19.50
W12620	20 Way	2.20	29.50	28.00
W12625	25 Way	2.50	32.50	29.00
W12626	26 Way	2.60	34.00	32.00
W12634	34 Way	2.80	44.00	42.00
W12636	36 Way	3.00	49.00	47.00
W12640	40 Way	3.20	55.00	52.50
W12650	50 Way	3.75	62.00	59.50

Plus 20% tax where applicable

COMPUTER CONNECTORS

Cat No.	Description	1-99	100+
P10900	DB25 Plug	1.30	1.20
P10901	DB25 Socket	1.40	1.30
P10902	DB25 Cover	.80	.65
P12210	Centronics Solder	3.50	3.15
P12200	Centronics Crimp	4.50	4.00
P10880	DB9 Plug	1.30	1.20
P10881	DB9 Socket	1.40	1.30
P10882	DB9 Cover	0.60	0.55
P10890	DB15 Plug	1.30	1.20
P10891	DB15 Socket	1.40	1.30
P10892	DB15 Cover	0.65	0.55

Plus 20% tax where applicable

CANNON TYPE CONNECTORS

	1-9	10+
3 Pin Line male Cat. P10960	1.80	1.60
3 Pin Chas male Cat. P10962	1.90	1.70
3 Pin line female Cat. P10964	2.50	2.20
3 Pin Chas FMle Cat. P10966	2.90	2.50

Plus 20% Sales Tax where applicable

CARD EDGE CONNECTORS

Edge Connectors to Disk Drives Etc.

		10-24	25-99	100+
P12060	10 Way	2.95	2.50	2.10
P12062	20 Way	3.25	2.75	1.95
P12064	26 Way	3.55	2.95	2.20
P12066	34 Way	3.95	3.50	2.30
P12068	40 Way	4.50	3.90	3.50
P12070	50 Way	5.50	4.50	3.90

Plus 20% Sales Tax where applicable

UNPROTECTED STRIP HEADERS

Dual in Line 2.54mm

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P12240	10 Way	1.25	1.10
P12246	16 Way	1.35	1.20
P12250	20 Way	1.45	1.25
P12256	26 Way	1.50	1.40
P12260	30 Way	1.75	1.65
P12264	34 Way	1.95	1.75
P12270	40 Way	2.25	1.95
P12275	50 Way	2.75	2.50
P12280	60 Way	2.95	2.75

Plus 20% Sales Tax where applicable

R.A HEADERS

		1-9	10+
P12241	R.A. 10Way	1.45	1.30
P12247	R.A. 16Way	1.55	1.40
P12251	R.A. 20Way	1.65	1.45
P12257	R.A. 26Way	1.70	1.50
P12261	R.A. 30Way	1.95	1.85
P12265	R.A. 34Way	2.15	1.95
P12271	R.A. 40Way	2.45	2.15
P12276	R.A. 50Way	2.95	2.70
P12281	R.A. 60Way	3.15	2.95

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IDC SOCKETS

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P12100	10 Pin	1.95	1.75	1.25
P12101	16 Pin	2.25	2.05	1.65
P12102	20 Pin	2.45	2.25	1.90
P12104	26 Pin	2.65	2.45	2.00
P12106	34 Pin	2.75	2.55	2.15
P12108	40 Pin	2.95	2.75	2.25
P12110	50 Pin	3.50	2.95	2.50

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Desc.	Cat. No.	1-9 boxes	10+ boxes
S/S D/D	C12440	$14.50	$13.90
D/S D/D	C12445	$16.50	$14.90

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VERBATIM DATA LIFE DISKETTES

	10-99	100+
5¼" SS/DD MD525-01	2.50	2.35
5¼" DS/DD MD550-01	3.20	2.75

XIDEX DISKETTES

5¼" SS/DD 5012-1000	2.50	2.50
5¼" DS/DD 5022-1000	3.40	3.05
3½" SS/DD 3012-3000	5.90	4.75
3¼" DS/DD 3022-3000	6.90	5.55

Plus 20% tax where applicable

DISK DRIVE FOR 6502 SYSTEM (APPLE* COMPATIBLE)

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$165	*$135*

Plus 20% tax where applicable
*(*IBM is a registered trademark)*

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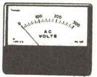
4853	5¼" 1M	$265	$245	$215
4854	5¼" 1.6M	$295	$260	$235
2896	8" 1.6M	$650	$625	$600

Plus 20% tax where applicable



PANEL METERS

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Q10500	MU45 0-1mA	7.50	6.95
Q10502	MU45 50-0-50uA	7.50	6.95
Q10504	MU45 0-100uA	7.50	6.95
Q10505	MU45 0-50uA	7.50	6.95
Q10510	MU45 0-5A	7.50	6.95
Q10518	MU45 0-1A	7.50	6.95
Q10520	MU45 0-20V	7.50	6.95
Q10535	MU45 VU	8.50	7.75
Q10530	MU52E 0-1mA	9.95	8.35
Q10533	MU52E 0-5mA	9.95	8.35
Q10538	MU65 0-50uA	10.50	9.35
Q10540	MU65 0-1mA	10.50	9.35
Q10550	MU65 0-100uA	10.50	9.35
Q10560	MU650 0-20v	10.50	9.35

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FANS

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Cat. T12461	240V 4½"	10.50	10.00
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Cat. T12463	115V 4½"	10.50	10.00
Cat. T12467	115V 3½"	10.50	10.00

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Y11000	1MHz	HC33	5.50	4.75
Y11005	2MHz	HC33	2.25	1.95
Y11008	2.4576MHz	HC18	2.25	1.95
Y11015	3.57954MHz	HC18	1.20	.90
Y11020	4.00MHz	HC18	1.30	.90
Y11022	4.194304MHz	HC18	1.40	.90
Y11025	4.75MHz	HC18	1.40	.90
Y11026	4.9152MHz	HC18	1.40	.90
Y11042	6.144MHz	HC18	1.40	.90
Y11050	8.00MHz	HC18	1.40	.90
Y11055	8.867238MHz	HC18	1.40	.90
Y11070	12.00MHz	HC18	1.40	.90
Y11072	14.318MHz	HC18	1.40	.90
Y11080	16.00MHz	HC18	1.40	.90
Y11085	18.432MHz	HC18	1.40	.90
Y11090	20.00MHz	HC18	1.40	.90

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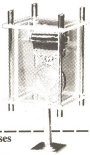

50 and 25 years ago...

"Electronics Australia" is one of the longest running technical publications in the world. We started as "Wireless Weekly" in August 1922 and became "Radio and Hobbies in Australia" in April 1939. The title was changed to "Radio, Television and Hobbies" in February 1955 and finally, to "Electronics Australia" in April 1965. Below we feature some items from past issues.

Wireless Weekly

September 1936

Home movies: (advertisement) Make your own moving pictures and show them with the Campro movie camera and combined projector. Operates from battery or power point. No separate project is required. No focussing, no darkroom. Press the lever and "shoot" the scene. You can load and unload in broad daylight. Price 8 pounds, 19/6.

Charge for battery charging: One of the biggest troubles which beset the countryman who buys a radio set is the matter of charging his batteries. Every battery set must use an accumulator which needs periodic re-charging. This means that, particularly if he is in an outlying district, he must make some arrangements to see that his accumulator ca be charged easily and with the minimur of lost time. Unfortunately, the matte of expense will come into it as well – some depots will charge up to 7/6 for 6-volt battery.

Electric Gramophone: There seems t be a growing demand for gramophon motors and pick-up units which wi allow set owners to play their gramc phone records through their radio re ceivers. Practically every radio set thes days is equipped with pick-up terminals which only need connection to a pick-u for ready operation.

The use of a pick-up demands, first c all, the pick-up itself, and secondly, motor to take the record. Some peopl have old gramophones which they us for this purpose, but not only are thes worked with old-fashioned sprin motors, but also are awkward, unsight ly, and take up too much space.

Radio in France: One French paper say that the way French announcers spea French "would shame even an Englis man".

RADIO, TELEVISION and HOBBIES

September 1961

CB Radio: (editorial) Since the publication of our last issue, carrying an article on the U.S. Citizen's Radio Service, we have had consistently favourable reaction from individual readers and from trade representatives alike. Not a single person has voiced opposition to the suggestion that some similar scheme should operate in Australia.

Plenty, however, have criticised local "red tape" and made dark suggestions as to why Australian citizens have been denied as free use of radio channels as they would like. Mostly, these centre around the fact that the Postmaste General's Department also derives rev nue from the nation's telephone system

No redundancy worries: A great de has been said about "electronic brains displacing human labour. The fact that the rapid adoption of electron computing devices has created the nee for a veritable army of specialists to d sign, build, sell, use and service them Already, young people are building en tire careers around this rapidly expanc ing facet of electronic art.

Conductive paint: From Japan com news of an electrically conductive pai said to provide a coating with good co ductivity, high mechanical strength ar excellent flexibility.

The paint consists of a mixture very small metallic particles and slight larger granules of thermoplastic res dispersed in a liquid.

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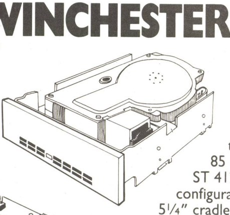

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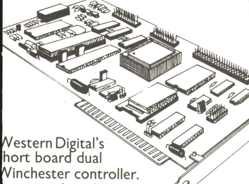

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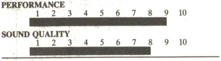
Compact Disc Reviews

by RON COOPER

RACHMANINOV

Piano Concertos No. 2, Op. 18 in C minor.
Piano Concerto No. 4 Op. 40 in G minor.
Vladimir Ashkenazy, piano.
Concertgebouw Orchestra conducted by Bernard Haitink.
Decca CD 414 475-2 DDD.



Rachmaninov was very sensitive about the opening of his second concerto, believing after hearing criticism, that the first theme was just an introduction and not a theme at all. With the work being an instant success and now regarded as standard repertory it would appear that Rachmaninov was perhaps a little over sensitive.

However, this could possibly be attributed to the catastrophic performance of his first symphony in 1897, after which he was unable to compose anything of importance for the next three years.

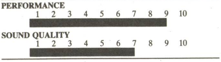
In contrast the fourth concerto took a good deal longer to become established. It was composed in New York in 1926.

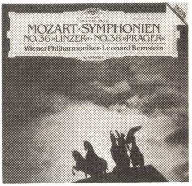
This recording, like the previous ones reviewed in this issue, is another gem, being expertly performed, with accepted tempos and recorded 'right' for this type of work.

There is a fair amount of acoustic ambience but this does not detract from the full overall sound. (R.L.C.)

MOZART

Symphony No. 36 in C major, K425, "Linz".
Symphony No. 38 in D major, K504, "Prague".
The Wiener Philharmoniker conducted by Leonard Bernstein.
Deutsche Grammophon CD 415 962-2 DGG.
Playing time: 60 min 7 sec.



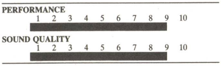

MOZART · SYMPHONIEN
NO. 36 »LINZER« · NO. 38 »PRAGER«
Wiener Philharmoniker · Leonard Bernstein
DIGITAL

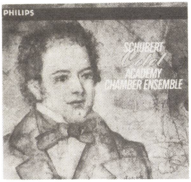
The creative process of a great artist is beyond our natural understanding and defies precise scientific explanation. With all attempts to account for it, it is still an inexplicable mystery. Perhaps this is the experience of anyone tryin to reveal the essential being of a wor of art.

As an example, the Linz Symphon which Mozart dashed off in great haste bares no sign of this in the end result. I was written during a tour and on arriving at Linz, Mozart wrote to his father "On Tuesday 4th November I am givin

SCHUBERT

Octet in F, Op. posth. D. 803.
Academy Chamber Ensemble, Iona Brown & Roy Gillard, violins.
Philips CD 416 497-2 ADD.
Playing time: 57 min 22 sec.





This major work composed in 1824, is scored for three wind and five string instruments and like the 'Trout' was commissioned work. It uses man modulations — somewhat disliked b some critics of the period but it show Schubert's style and the aesthetic norm of the time.

Amazingly, it was completed in littl over a month. A reviewer of the secon performance states: "It consists of si fairly long movements; a very substantial composition . . . well thought out a regards the structure. The harmoni form is regular throughout but at th same time full of genuine originality the instrumental combination . . . is excellent and highly effective in the variations — and the consistency of the thematic composition — such a rarity thes days — deserves much praise."

For those who are unfamiliar wit this work as a whole, they will probabl recognise the popular 3rd and 5t movements.

This disc is chamber music at its best The Academy show their usual sensitivity and skill in this recording which i just excellent. The fact that it is an analog recording made nine years ago i immaterial and to me it is state of th art both musically and technically.

The pity is that Philips don't giv credit to the recording team. (R.L.C.)

ı concert in the theatre here — and, as [have not a single symphony with me, I m writing a new one at breakneck peed, which has to be finished by hen.”

It certainly was, and it has been estimated that even a good copyist would ave had difficulty just to copy the core in such a short time.

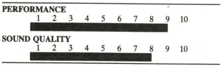
The delightful Prague Symphony orms a link with the triptych of his last ymphonies and has contrasts of fiery emperament with a slightly sad section vhich only enhances the deep feeling his work conveys.

This late, all digital disc is a big improvement (soundwise) over the last Mozart symphonies I reviewed in June, nd by comparison is a joy to listen to. Balance, which I have criticised before vith DGG recordings is improved, but here is a slight edginess to the strings nd they are almost mono — predominantly left channel.

However, taking the music, the excelent tempos and the fine playing all into ccount makes this a worthwhile disc. R.L.C.)

BEETHOVEN

Piano Sonata No. 15 in D major, Op. 28 “Pastoral”.
Piano Sonata No. 17 in D minor, Op. 31 No. 2 “The Tempest”.
Emil Gilels, piano.
Deutsche Grammophon CD 419 161-2 DDD.
Playing time: 54 min 7 sec.



The piano sonatas that Beethoven wrote in the early 1800s have a fantasy like character which is very different from his previous sonatas. The movements within such pieces as Op. 26 and 27 Nos. 1 and 2 are characterised by their untraditional ordering and contrasting emotions, whereas the Op. 28 (in comparison) seems far more ‘normal’, conveying a more pleasantly relaxed feeling. The rather calming title ‘Pastoral’ was attached to it by the Hamburg publisher Cranz.

According to Carl Czerny (one of Beethoven’s pupils) when he was writing his three Op. 31 sonatas, he was not satisfied with his works up to that date (c.1802).

It is on solo piano works such as these where the CD format really excells. There appears to be nothing between the notes (not even a cough).

Gilels shows a great ‘feeling’ in his playing of these lesser known Beethoven Sonatas and coupled with a good well balanced recording it makes this an excellent disc. (R.L.C.)

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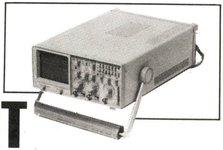

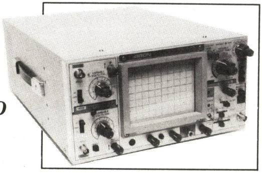

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Information centre

Problem with Radio Direction Finder

I have been reading your magazine for some 12 years and have been impressed with the general content and layout throughout those years.

Recently, a Radio Direction Finder was described (EA, February 1986) and a kit duly purchased from the local Dick Smith store. After setting up the RDF, the LEDs spun around in a clockwise direction and, after some time, the rate at which the LEDs moved slowed down to a complete halt, after which the LEDs started turning anti-clockwise.

Is this problem due to: (1) the master clock (1MHz) not running at the correct frequency; (2) the 4046 PLL IC losing lock after the setting up procedure; or (3) the surrounding components drifting in value?

Your help in this matter would be greatly appreciated. Keep up the good work. (D.M., Moonah, Tasmania.)

• You'll no doubt be pleased to learn that your DFM is functioning quite normally. The LED display should only lock when a signal carrier is present or when test point TPA is shorted to test point TPB during the setting up procedure.

At other times, the PLL will be out of lock and the LEDs will rotate due to variations in the 1MHz clock frequency.

Thank you for your comments regarding the magazine.

How to use the RLC Bridge

I'd appreciate it if you could give me some advice on how to use the March 1978 RLC Bridge. I've purchased the kit, but can't figure out how to use it as there isn't enough information in the article. (A.R., West Brunswick, Vic.)

• Use of the RLC Bridge involves a repetitive (or iterative) nulling procedure. Begin by setting the range and the C/R&L switch as appropriate, then set the gain to about mid range and the loss control to minimum (ie, fully anti-clockwise).

Now adjust the cursor until the meter nulls (ie, adjust for a minimum reading). Once the null has been found, advance the gain control and again adjust the cursor until the meter nulls. Continue this process until the gain control is fully advanced.

Note that if a null cannot be found, the range switch should be switched to the next range.

When measuring electrolytic and low value ceramic capacitors, which have a higher power factor than plastic dielectric capacitors, the loss control should also be progressively advanced to obtain the best possible null.

Electronic ignition and sports coils

In answer to G.A., Chermside, Qld in the July 1986 issue, I would like to make the following points:

1. The voltages quoted for the Accel coil are open circuit voltages. This is a typical advertising gimmick where bigger means better. How can anybody imagine 85kV floating around a distributor cap?

2. The only valid voltages are plug voltages which mainly depend on (a) plug gap and (b) compression ratio.

3. With a dwell-extended transistor ignition system, there is enough energy left at sensible RPM levels with a standard coil.

4. With a good CDI system, a standard coil is all that's required, apart from a properly insulated ignition harness (eg, slip PVC tubing over all HT leads).

In closing, I would like to say that my latest CDI using crankshaft triggering will run way past 12,000 RPM on a V8, as simulated on a test rig. I hope that this will shed some light on these problems. (J.V., Prospect, NSW).

• Thanks for your letter J.V. We agree that a standard ignition coil is quite adequate for the transistor ignition systems with dwell extension.

No shocks from electric fence

I am having problems with the electric fence described in December 1985.

Having assembled three of these kits purchased from Jaycar, I am unable to keep the fence in continuous operatior because the inverter transistors (Q1 anc Q2) continue to short out once SCR1 i replaced in the circuit.

Please advise if any modification were made to the abovementioned kits Jaycar has advised me to seek your ad vice. (D.D., Evans Head, NSW).

• It sounds as though the regulator cir cuit associated with IC2 is not workin correctly, thereby causing the transistor to over dissipate. To troubleshoot th circuit, remove the SCR and measur the inverter output voltage. You shoul get a reading of 270V.

Next, check that the voltage on pin of IC2 is about 5.1V. If you don't ge the correct voltage, check the component values around IC2, with particula emphasis on the 220kΩ resistor on pi 2, and 5.1V zener on pin 3, and th 100MΩ resistor between pin 2 and th inverter output.

You should also check the undersid of the board for short circuit or ope circuit tracks. It's also quite possibl that the coil has been incorrectly woun or terminated (eg, the start and finis ends of the primary windings may hav been transposed).

Notes and errata for this project wer published in February and May 198 and should have been included with th kit instructions.

Problem with video fader

I would appreciate your assistance i regard to the Video Fader (EA, Janu ary 1986) which was built from a Jayca kit.

At first switch-on, the LED was di and the 7805 became hot with only 2 at its output. Removal of IC1, the 740 cured the overload so it was duly re placed and the output and the LED re turned to normal operation. The result ant action is as follows:

1. Rotation of VR1 causes a smoot fade to black.

2. With VR1 adjusted fully anti-clock wise (no fade), the picture is dark wit no colour.

3. As VR2 is adjusted clockwise (ap proximately three-quarters of its travel

colour suddenly appears but is oversaturated and causes a "grainy" picture with some horizontal image tearing. Advancing VR1 further simply worsens the tearing and the monochrome content is still too dark.

4. With VR2 set to the "sudden colour appearance" point, the slightest movement of VR1 towards fade causes both the tearing and colour to disappear.

I hope you can help with some diagnostic tips as I have been building EA kits for about 20 years and this is the first one that has me stumped. (D.G., Canberra, NSW).

- The fact that the picture is not bright enough, even with VR1 set to the no-fade position, indicates that the problem s related to the biasing of the fader network. Try reducing the value of the 8.2kΩ resistor in series with VR1 (eg, o 6.8kΩ). This should brighten the picture.

It should not be necessary to use VR2 o make adjustments to the colour saturation. Its function is simply to set the black level of the faded signal. The grainy picture and oversaturated colour are classic symptoms of excessive signal level, indicating that VR2 has been advanced too far.

This should not be necessary if the fader control VR1 is made to operate correctly.

Utopiatronics and 3½-digit displays

In reference to your article "Utopiatronics" in the July 1986 edition of *Electronics Australia,* I would like to record my willingness to build more projects if it were possible to buy the funnies such as the PCB, case, Scotchcal labels and other items developed or imported specially for the project in question. I am sure that there are many who wish to build a project but not immediately, and therefore do not wish to outlay the full cost all at one hit.

By buying the "funnies" only, these can be put aside until required without the risk that the special parts may no longer be available when the opportunity presents itself to commence construction.

Somewhere along the line my education has suffered a loss. What in the name of blazes is a 3½-digit display? Has one of the digits been cut in half? I have asked the salesmen in various electronic component shops what the term means and their reply is "I don't know".

In the past you described some projects using a DPM200 display unit. The cost of this seems to have increased tremendously. Is there some other display unit that will do the job at a more reasonable price?

As a reader since about 1934, I wish your magazine every success. (J.S., Macleod, Vic).

- A 3½-digit display is simply a display in which the leftmost (or most significant) digit is either a "1" or a suppressed (ie, blank) zero. Thus, ignoring decimal points, the maximum reading that can be displayed on a 3½-digit display is 1999.

This means that, when the display is manufactured, only the B and C segments are incorporated for the most significant digit. The remaining segments, which are necessary to display numbers greater than "1", are simply not included.

There's not much alternative to the DPM200, although in most cases it should be possible to use the DPM400 which is about $10 cheaper.

Figaro, Figaro — wherefore art thou?

I recently inquired about the availability of the Figaro TGS812 gas sensor as used in the breath tester kit. You kindly informed me that the sensors are no longer imported.

I am rather keen to obtain one and wonder if you could further help me by forwarding information on the company which manufactures them. I might try to get one flow in if that's possible. (I.L., Marryatville, SA).

- We've managed to track down an Australian supplier for TGS812 gas sensor: Phoenix Industrial Pty Ltd, 68 Alexander St., Crows Nest, NSW 2065. Telephone 438 3966. Stocks were rather limited though.

Notes and Errata

0V/5A LABORATORY POWER SUPPLY MK.2 (May 1985, File 2/PS/63): the 100μF electrolytic capacitor across the positive output is shown on the wiring diagram with reverse polarity. In addition, the emitter and base leads are transposed on the BD139 package outline drawing on the circuit diagram.

COMPRESSOR FOR COMPACT DISCS (May 1986, File /MS/32): the printed circuit board artwork has an error. The negative lead of the 470μF filter capacitor for the positive supply has been incorrectly connected to the "IN" terminal of the 912 regulator. It should go to the "GND" terminal, as shown in the circuit diagram.

To correct this error, cut the track adjacent to the "IN" terminal and connect the negative terminal of the capacitor to GND using a small wire link.

Note also that the parts list calls for four 10μF non-polarised electrolytic capacitors. These should be in fact 2.2μF non-polarised electrolytics as shown in the circuit and parts layout diagrams.

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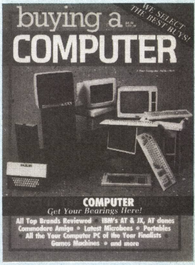
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Proton's D940

Continued from page 34

For the continuous power testing, we measured 61 watts into a single channel and 56 watts with both channels into 8-ohm loads. Into 4-ohm loads, this rose to 120 watts for a single channel and 80 watts for both, indicating that this amplifier does not run into early current limiting.

With the anti-clip circuit in operation though, the power output dropped slightly, giving 40 watts per channel into 8-ohm loads and 60 watts per channel into 4-ohm loads. We were not inclined to make much of this latter result though, because by its very nature, the anti-clip circuit is intended to work more on transient rather than steady-state signals. The above performance figures confirmed the rated distortion of the D940 at less than .02%.

With toneburst signals, according to the IHF dynamic power test, the Proton delivered the goods. We measured 225 watts into an 8-ohm load for a single channel or 189 watts for both channels. For a 4-ohm load, the single channel figure was 378 watts and for both channels, 312 watts. And then for 2-ohm loads, the figures were 506 watts and 451 watts respectively.

All of which adds up to an enormous power output for such an innocuous-looking receiver. Not only that, but Proton go so far as to criticise the IHF (Institute of High Fidelity) dynamic power spec and reckon that the D940 will deliver its transient power for bursts up to as long as 300 milliseconds — 15 times longer than the IHF requirement.

Other amplifier measurements substantially confirmed the D940's specification. Bass boost and cut at 100Hz was +8, −8.5dB, and treble boost and cut at 10kHz was the same. Channel separation was −80dB at 100Hz, −72dB at 1kHz and −58dB at 10kHz (worst channel figures quoted). Phono signal-to-noise ratio was 83dB unweighted with respect to 10mV at 1kHz and 40 watts output, for moving magnet cartridges. This is a good figure. Overlead capacity for the phono input was 180mV at 1kHz which again is a good figure. The equivalent S/N ratio for moving coil cartridges was around 72dB unweighted, depending on the load conditions selected. These are also good figures.

For the high level inputs, the S/N ratio proved to be around 87dB which is good although hardly earth-shattering in these days of compact disc players.

For the FM tuner, the Proton als proved to be a good performer althoug its measurements again are not excep tional. For example, ultimate S/N rati in mono mode was 80dB and 68d (both figures unweighted) in stereo Total harmonic distortion was 0.18% i mono and 0.37% in stereo, at 1kHz Separation between channels wa −36dB at 50Hz, −39dB at 1kHz an −37dB at 10kHz which is fairly close t the claimed specification.

AM tuner performance is strictl mono, with bandwidth and distortion t match; ie, narrow, 2.7kHz and wit about 56dB S/N ratio at best — stea radio.

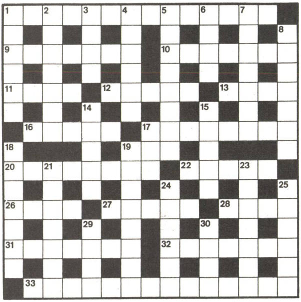
The really outstanding feature of th Proton D940 is its phenomenal transie power output. DPD transforms it fro a fairly ordinary machine with a goo range of control features into a turb powered performer that really delive tremendous power. For that alone, it a winner. The recommended retail pri is $879.

For further information, contact yo hifi dealer or the Australian distributo W. C. Wedderspoon Pty Ltd, 3-5 Fo St, Greenacre, NSW 2190. Phone (0 642 3993.

SEPTEMBER CROSSWORD

ACROSS

1. Conductive network. (7,7)
9. Component of radio system. (7)
10. Said of an electrolytic cell. (7)
11. The Faraday ________ provides electrostatic screening. (4)
12. British scientist famous for studies of stellar dynamics. (5)
13. Fluffy dirt. (4)
16. Group of solar cells, etc. (5)
17. Said of laser light. (8)
19. Tape machine. (1,1,1)
20. Longer play of certain recordings. (8)
22. Memory. (5)
26. Nature of film in electronic applications. (4)
27. What counterfeit speakers do? (5)
28. Cable format. (4)
31. Type of keypad, etc. (7)
32. Return the spot across a CRO. (7)
33. Tower in communications system. (10,4)



DOWN

1. Originator of the quantum theory. (6)
2. Whole number. (7)
3. Aspect of sound quality. (4)
4. Dampen. (6)
5. One devising something new. (8)
6. Send a radio message. (4)
7. What one has to do to get the picture? (7)
8. Type of tape base. (7)
14. What a security beeper does. (5)
15. Discoverer of electromagnetic waves. (5)
17. Charge-coupled device. (1,1,1)
18. Interfering, as waves do. (7)
19. Control on TV set, ______ hold. (8)
21. Tuning device. (7)
23. Information not yet processed by computer. (3,4)
24. Said of some coded data. (6)
25. Cause a 180° phase shift. (6)
29. Magnetic substance. (4)
30. It can exhibit red shift. (4)

SOLUTION FOR AUGUST

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Next month in Electronics Australia

Infrared Remote Control Preamplifier*

This new Infrared Remote Control Stereo Preamplifier lets you control volume, bass, treble and balance from the comfort of your lounge chair. You can also switch the unit on or off, select between signal sources, or select the loudness and muting functions. The first article is in September *Electronics Australia*.

Coming soon: 1GHz Digital Frequency Meter

Don't even think of building a new digital frequency meter until you've seen ours. We thought our old design published in December 1981 was pretty good with frequency and period measurements up to 500MHz. Our new design knocks the old one dead.

Here are its main features: frequency and period measurement up to 1GHz; much improved front end sensitivity and stability; high brightness LED displays; all pushbutton control; decimal point switching; LED mode indication; improved crystal timebase stability; and provision for external timebase.

In addition it's very easy to build and it won't break the bank. Wait for it — you'll be glad you did.

---

* *Note: although this article has been prepared for publication, circumstances may change the final content.*

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"With my HP CAD sail a boat that

Ask Ben Lexcen what his most valuable design tool is and he'll tell you it's his Hewlett-Packard Computer Aided Design system. Here he talks about his experience with the HP system and offers some salient advice to the new generation of designers who will follow in his wake.

Have you always felt at ease working with computers?

"No way! Really I was a latecomer to computers because I didn't have any formal training and I was frightened of them. In fact, I used to dream up some wonderful excuses to avoid getting involved with them.

"But, of course, I realise now that if you're going to be a leader in any field, not just design, you've got to utilise the leading technology. And really this HP stuff is so easy to use, I'm not sure what I was frightened of."

Which parts of a boat do you design with the help of the computer?

"Virtually the whole lot, with the exception of tiny mechanical things. But we use it to design the shape and structure of the boat, and the sails.

"We use it to do all the hydro-dynamic considerations such as the total drag of the hull unit. Plus we use the computer to test different hull shapes."

What aspect of your involvement with Hewlett-Packard strikes you as being particularly beneficial?

"Well, once you become involved with HP, you'll soon realise that apart from their technical excellence and innovation, one of their major strengths is that they have the people to help you get the best results from CAD.

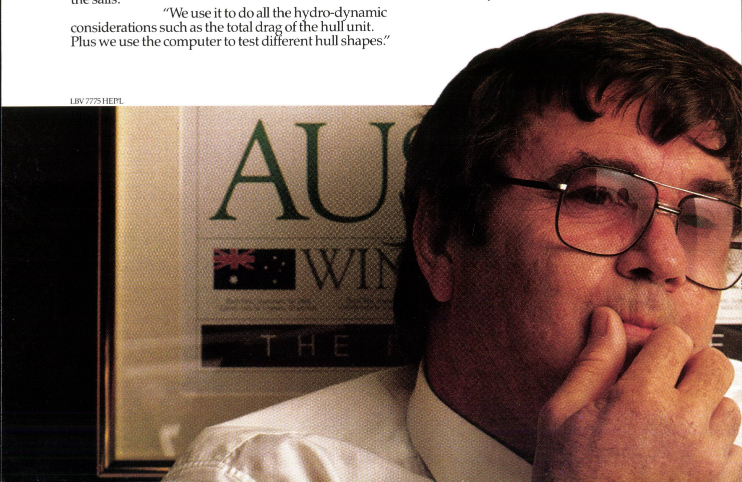
"Because HP supply the hardware and the software, you've got a terrific advantage over the guy who tries to work with a lot of different suppliers. I mean it counts for a lot when the person who writes the software understands the workings of the processor.

"If you've got questions or problems, you can get answers and solutions from the one place. And believe me, that can save a lot of time and worry."

How has the HP equipment assisted in the day-to-day running of your office?

"Well, it's staggering how much faster we can get things done since we plugged into HP. This is mainly due to the fact that the computer does so much of the calculation which we used to labour over manually.

LBV 7775 HEP/L



ystem I can virtually oesn't exist.”

Ben Lexcen

“For instance, now I can create the basic shape of a boat in a matter of hours whereas it used to take about a month. It might take me about ten minutes to do a keel whereas before it might have taken a week.”

Does saving so much time mean that you have to compromise on quality or accuracy?

“Absolutely not. The equipment is dead accurate and I can do a more thorough job for far fewer man-hours.

“In fact, we are so confident in the HP equipment that when we've settled on the design of the boat to defend the America's Cup, we won't tank test it in Holland, we'll test it here in the computer. And when you're talking about a million dollar boat, you've got to be damn sure you've got the right equipment to do it.”

What of CAD in the future?

“Look – I'm sure that if Australian designers don't grab CAD with both hands and run with it, the rest of the world will pass us by. And once we all realise its potential, you're going to see a lot of very happy and satisfied people in all sorts of design offices.”

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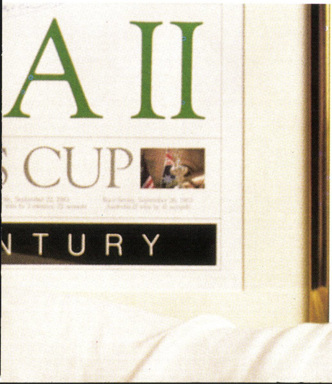

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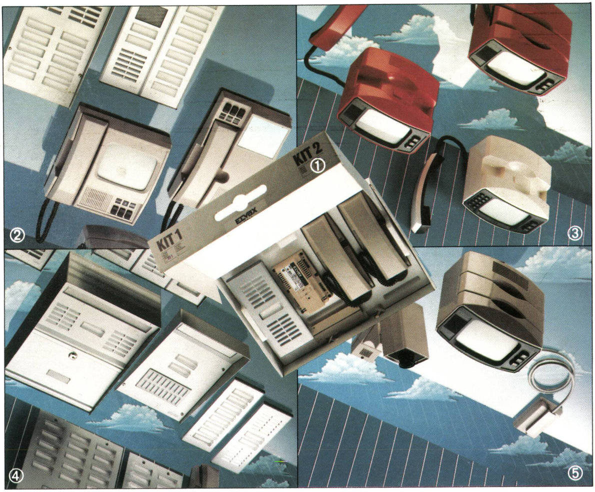

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